REMEDIAL ACTION SELECTION REPORT

Bayonne Barrel and Drum Site
Newark, New Jersey

Prepared For:

Bayonne Barrel & Drum PRP Group / *de maximis, inc.*

December 22, 2005

QUEST

Environmental & Engineering Services, Inc.

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1.0 INTRODUCTION

This document presents a Remedial Action Selection Report ("RASR") for the Bayonne Barrel and Drum Site ("Site") located in Newark, New Jersey. The RASR identifies, evaluates, and proposes a remedial alternative that will allow beneficial reuse of the Site. The selected remedy is compatible with State and Federal regulations, future use scenarios for redevelopment, and remedies accepted for other sites with comparable conditions. The RASR was prepared pursuant to the New Jersey Technical Requirements for Site Remediation (N.J.A.C 7:26E-5.2). Soil and ground water quality data appearing in the *Remedial Investigation Report* dated January 17, 2005 were used to develop the proposed remedial action. The New Jersey Department of Environmental Protection ("NJDEP") Office of Brownfield Reuse and the United States Environmental Protection Agency ("USEPA") Region II Removal Action Branch provide regulatory oversight for Site remediation. The responsible party for the Site is the Bayonne Barrel & Drum PRP Group ("Group"). The City of Newark is the property owner.

1.1 REGULATORY BACKGROUND

The Bayonne Barrel and Drum Company operated a treatment, storage and disposal facility on the property from 1940 to the early 1980's. The facility mechanically and chemically reconditioned and recycled used drums for resale and reuse. Materials used in the drum reconditioning operations included detergents, caustic cleaning solutions, solvent based cleaning solutions, solvent based paints, and thinners. Sources of the reconditioned drums reportedly included food and cosmetics, petrochemicals, herbicides and pesticides, military use, and solid and hazardous waste facilities. During May 1982, the Bayonne Barrel and Drum Company was cited for violations of the Resource Conservation and Recovery Act ("RCRA") by the USEPA, including the storage of hazardous waste without a hazardous waste permit. Two months later, the Bayonne Barrel and Drum Company filed for protection from creditors under Chapter 11 of the Bankruptcy code and subsequently ended operations during 1983. Several tenants utilized the property between 1983 and 1990 for a variety of businesses. The Site has been abandoned since 1990, and access to the Site from 1990 to 2003 was unrestricted. The City of Newark is the current property owner.

During the 1980s and early 1990's, the USEPA's RCRA Branch and the NJDEP were involved with the Site. USEPA site inspections conducted in 1984, 1988 and 1991 confirmed the presence of numerous hazardous substances at the Site, including, but not limited to: polychlorinated biphenyls

("PCBs"), toluene, trichloroethylene, vinyl chloride, chromium, lead, zinc, benzene and xylene, some of which may have been connected to the site's earliest use as the City of Newark's "15E Landfill". In September 1991, the NJDEP requested USEPA to evaluate the Site for a Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA") removal action. The USEPA completed a Removal Site Evaluation ("RSE") during January 1992 and concluded CERCLA hazardous substances had been released to the environment. A Health Consultation performed by the Agency for Toxic Substances and Disease Registry in conjunction with the RSE indicated that conditions at the Site posed a potential public health threat.

The USEPA Removal Action Branch performed additional site inspection and removal activities during 1994-1995. Inspections revealed ash piles, shredded tires, aboveground and underground storage tanks, contamination within buildings, and the presence of thousands of drums, some containing hazardous substances. Removal activities included the removal of approximately 46,000 drums, removal of two ash piles contaminated with dioxin and lead, and the removal of tanks containing contaminated sludge.

Previous environmental site investigations were performed at the Site from 1985 - 1998 and included the following:

- Dan Raviv Associates Inc. (1985 - 1986) in compliance with a Consent Agreement between Bayonne Barrel and Drum and USEPA
- Louis Berger and Associates (1986) in connection with a proposed acquisition of the property (right-of-way) for an expansion of the NJ Turnpike.
- USEPA (1994-1995) in conjunction with the removal action.
- Blasland, Bouck & Lee Inc./*de maximis, inc.* (1997) in compliance with an Administrative Order of Consent between the Group and USEPA to determine the nature and extent of soil contamination.
- USEPA contracted Roy F. Weston, Inc. (1998) for monitoring well sampling.

The results of these investigations indicated the presence of numerous organic and inorganic contaminants in soil that exceed New Jersey Soil Cleanup Criteria including petroleum hydrocarbons, pesticides, volatile organic compounds ("VOCs"), PCBs, polycyclic aromatic hydrocarbons ("PAHs"), metals (such as lead, arsenic, zinc) and polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans ("dioxins/furans"). The investigations also revealed the presence of historic fill across the Site that contributed to the soil contamination. Monitoring well sampling revealed the presence of several contaminants (e.g., metals, VOCs, PAHs) in ground water.

In response to the City of Newark's desire to re-develop the Site for beneficial reuse, *de maximis, inc.*, on behalf of the Group, developed a draft Statement of Work (SOW) in February 2002 proposing remedial activities to control the sources of contamination and reduce or minimize the migration of the contamination in the context of future use scenarios developed for the Site. The draft SOW included demolition and removal of remnant wastes and associated storage structures, solidification/stabilization of selected soils, and capping of soils as a containment measure. The USEPA, after reviewing prior site data and the draft SOW, requested additional investigation of soil in the vicinity of the buildings to complete the characterization of the entire Site. This investigation was completed by Quest Environmental & Engineering Services, Inc. ("Quest") during July-August 2002 and indicated that the remedial activities outlined in the draft SOW would also be applicable to areas encompassed by the buildings.

During August 2002, the Group requested that the NJDEP review the draft SOW and prior site data for approval of the proposed remedial activities. After their review, the NJDEP required additional sampling to address the remedial investigation requirements of the Technical Requirements for Site Remediation ("TRSR"). The NJDEP also requested that the Group enter into a Memorandum of Agreement ("MOA") to allow the NJDEP to review and provide oversight of remedial activities. The Group voluntarily entered into a MOA for Non-Residential Properties (No. NJD009871401) on October 21, 2002. The Group submitted a Remedial Investigation Workplan during March 2003 to comply with the TRSR. The Remedial Investigation Workplan ("RIW") was approved on August 11, 2003. Concurrent with development of the RIW, a *Historic Fill Report* dated February 4, 2003 was prepared for the Site concluding that the presence of historic fill on site was a source of certain chemicals (i.e. metals and polycyclic aromatic hydrocarbons - PAHs) detected in Site soils. In a letter dated June 18, 2003, the NJDEP acknowledged that historic fill contributes to metal and PAH contamination in soil, but stated that site operations also appears to have contributed significantly to contamination in certain areas.

The Remedial Investigation ("RI") was performed during September 2003 to September 2004 and included: (1) additional characterization and delineation of soil quality at areas of concern ("AOCs") in accordance with the TRSR; (2) investigation of the current condition of ground water quality and verification of ground water flow; and (3) evaluation of potential ecological effects resulting from the presence of site-related chemicals of potential ecological concern. The results of the Remedial Investigation appear in the January 17, 2005 *Remedial Investigation Report*. The NJDEP and USEPA provided comments to the Remedial Investigation Report in a letter dated August 15, 2005. The NJDEP and USEPA approved the RI Report and conclusions conditioned upon performance of additional perimeter soil sampling, investigation of the storm sewers and ground water modeling. The additional investigations will be completed and the results incorporated into the overall remedial action plan for the Site. It is not anticipated that findings from these investigations will affect the proposed on-site remedy.

Under a separate Administrative Order of Consent with USEPA, the Group authorized the demolition of site structures. Demolition began in February 2004 and ended during June 2004 with the exception of off-site disposal of some wastes that were generated and remnant ash piles. Demolition of all site buildings was performed to grade. All building floor slabs and foundations were left in place with the exception of Building No. 5. Other demolition activities included as part of this work were removal of asbestos containing materials from the buildings prior to demolition; removal of various debris including construction/demolition materials and tires that were brought to the Site while vacant; removal of aboveground storage tanks and underground storage tanks; and cleaning and/or removal of a majority of the components of the wastewater collection and treatment system including septic/settling tanks, pipelines, trench boxes, and floor troughs. A layer of clean dense grade aggregate ("DGA") was placed on the ground surface surrounding the building slabs as temporary cover for exposed, disturbed contaminated fill areas. Removal and off-site disposal of generated wastes and remnant ash piles was completed during September 2005.

1.2 PURPOSE AND OBJECTIVES

The purpose of this RASR is to evaluate site data and select an appropriate remedial action that will be compatible with future use scenarios. Future use scenarios would include a commercial facility (e.g. large retail store) or a warehouse/distribution facility that is compatible with site redevelopment under the Portfields Initiative. The Portfields Initiative is a partnership of The Port Authority of New York & New Jersey ("PANYNJ") and the New Jersey Economic Development Authority ("EDA") to help private developers, communities and others transform underutilized and Brownfield sites into productive properties to support emerging market opportunities for ocean and air freight-related warehousing and distribution operations. Bayonne Barrel and Drum Site was identified as a candidate site for Portfields development and is well-suited for use as warehousing and distribution to support growth of the Port region. The Site meets a number of criteria for Portfields Initiative sites including: 1) location within the Port District; 2) access to major highways such as Routes 1/9 and NJ Turnpike; 3) adjacent to essential utilities and zoned appropriately for industrial use or designated for redevelopment; 4) close to key port, air freight, and other transportation hubs and infrastructure

(Newark Airport, Port Newark); and 5) developable for ocean or air freight-related warehousing/distribution.

The objectives of the RASR are to identify remedial action objectives, select a remedial action that meets the remedial objectives, and describe and evaluate the selected remedial alternative based on criteria appearing in the TRSR (N.J.A.C 7:26-5.1). The primary criteria used to evaluate and select the proposed remedial alternative are protection of human health and the environment, long-term effectiveness and reliability, implementability, consistency with the planned redevelopment of the site, and compatibility with applicable environmental regulations. Selection of the remedial alternative is based on evaluation of various remedial alternatives under a non-residential future use scenario and is based on a site-specific human health risk assessment that evaluates the concentrations of chemicals of concern in soil and ground water and the exposure pathways to human health given the anticipated future use of the site and the proposed remedy. The site-specific human health risk assessment is provided in Appendix A. This RASR will be used to support the development of a Remedial Action Workplan ("RAW") for Site remediation and redevelopment.

1.3 RASR ORGANIZATION

The remainder of this RASR is organized in the following sections:

- **Section 2:** **Summary of Site Conditions** – provides a summary on the status of the site.
- **Section 3:** **Remedial Action Objectives** - provides the applicable remediation criteria, conceptual site redevelopment and use, and the identification of receptors based on the future site use.
- **Section 4:** **Selected Remedial Action** - describes in detail the selected remedial action.
- **Section 5:** **Remedial Action Evaluation** - describes the evaluation of the selected remedial action against remedial criteria involving protectiveness and implementability and a summary of a site specific human health risk assessment prepared for the selected remedy .
- **Section 6:** **References**

2.0 SUMMARY OF SITE CONDITIONS

The following subsections summarize current site conditions including site location and characteristics, areas of concern, soil quality by area of concern, and ground water quality. A more detailed description of Site conditions is provided in the January 17, 2005 *Remedial Investigation Report.*

2.1 SITE LOCATION AND CHARACTERISTICS

The Bayonne Barrel and Drum Site occupies approximately 16 acres and is known as Block 5002, Lots 3 and 14 in the City of Newark, Essex County, New Jersey (Figure 2-1). It is located within an industrial area and is surrounded by large, heavily traveled roadways. The Site has an elongated shape and is bounded by Routes 1 and 9 to the north and west, the New Jersey Turnpike to the east and southeast, and a cinema property to the south (Figure 2-2). The nearest residential area to the Site is approximately one-half mile west of the Site. The Passaic River is located approximately 1,800 feet east of the Site and 2,600 feet north of the Site.

The ground surface is approximately 23 feet above mean sea level ("MSL") at the southwest corner of the property and gradually slopes down to the northeast to approximately 5 feet above MSL. Surface runoff follows site topography and is collected by a series of eight storm water catch basins located along the eastern boundary of the property. Presently there are no structures on site. Nine buildings had occupied approximately three acres within the northern portion, but were in poor condition and were demolished during early 2004. Additional structures included a sanitary/drum reclamation wastewater collection and treatment system and underground storage tanks. Nearly all of the waste water treatment system components and storage tanks were removed or abandoned in place during the building demolition. (Some of the piping below and around the building slabs remains in place and will be addressed during completion of the remedy.)

The ground surface within and north of the building area is covered by asphalt pavement or disturbed historic fill materials. The southern portion of the Site is open land and is covered by disturbed historic fill materials. The ground surface in this area is largely covered with grasses with many patches of barren ~~areas~~. There are no natural surface waters or wetlands on site. Two 30-foot wide gas transmission line easements traverse the Site from south to north and contain two 30-inch and one 16-inch underground natural gas transmission pipelines (Figure 2-2). The gas transmission pipelines are maintained by PSE&G and Williams-Transco.

2.2 GEOLOGIC / HYDROGEOLOGIC SETTING

The general geology of the Site consists of an upper fill layer, an organic silt/clay layer, a sand layer, and bedrock. The entire Site is underlain by a layer of historic fill ranging in thickness from approximately 17 feet at the southwestern corner of the property to approximately 5 feet at the central eastern boundary of the Site. A majority of the fill is characterized as black coal ash/cinders with various demolition debris including glass, brick, metal, wood, tar, and concrete. The source of this fill within southern and central portions of the Site is a former landfill known as the 15E Landfill, which was owned and operated by the City of Newark. Figure 2-3 shows the approximate boundary of the landfill on the Site, which encompasses approximately 8 acres. Bottom ash from a nearby coal-fired power plant also was reportedly used to fill a portion of the central eastern area of the Site (Diversified Environmental, 1992). The fill that is present within the northern portion of the Site and beneath most of the former buildings also consists primarily of coal ash/cinder, which was placed in this area during or prior to the early 1930's when the Site was initially developed. Fill present in the westernmost portion of the Yard Area is characterized as a gray-brown or orange-brown sand having little construction/demolition debris, and it underlies the coal ash/cinder fill.

Underlying the fill in most locations is a layer of natural organic silt/clay or meadow mat that ranges in thickness from two to five feet. This layer was deposited as a tidal wetland or floodplain of the Passaic River. It is absent at some locations such as at the former underground storage tanks area, building foundations, and at locations along the western portion of the Site. Reddish-brown sand underlies the silt/clay layer across the entire Site and is approximately 30 feet thick. The sand layer is of glacial fluvial origin. Approximately ten feet of dark red-brown silt underlies the glacial sands and grades to a more consolidated material containing fragments of dark red shale. This material represents an upper weathered zone of the Passaic Formation, and is mapped as a sandy mudstone in this region of New Jersey (USGS, 1998). The weathered bedrock zone is approximately 50 feet below ground surface.

Ground water occurs within the fill in most areas of the Site. It is located approximately 1 to 6 feet below ground surface in the area of the former buildings and ranges up to 15 to 18 feet below ground surface at the southwest corner of the property. Locally, ground water is perched above the low permeability clay layer/meadow mat, particularly following precipitation/recharge events. The perched water will infiltrate to the underlying sand layer at locations where the clay layer is absent.

Regionally, ground water above the clay layer/meadow mat and ground water in the sand layer are considered as one unconfined or water table aquifer, which has no confining layer between the top of the saturated zone and the ground surface. An earlier investigation determined that ground water is not tidally influenced at the Site, despite its proximity to the Passaic River (Weston, 1999a). Ground water flow in the sand and fill layers is to the east-southeast toward the Passaic River (Figure 2-4). The hydraulic gradient is relatively flat ranging from 0.002 ft/ft - 0.004 ft/ft.

2.3 AREAS OF CONCERN

Eight primary areas of concern have been identified during the prior site investigations, the remedial investigation and during Site demolition activities. The AOCs are shown in Figure 2-5 and include:

- **Furnace Courtyard** – A 0.3 acre area including Building No. 2 where open head drums were incinerated and rinsed.

- **Waste Water Collection and Treatment System** – Conveyance structures (trench boxes, septic tanks, pipelines, and floor troughs) that discharged to the wastewater treatment area located within the Storage Tank Area. Treated water was discharged via a pipeline leading to the north of the Site that connected to a sanitary sewer system. Solid wastes were shipped off site.

- **Storage Tank Area** – A 0.8 acre area east of Building No. 1 where wastewater and oil generated from drum cleaning and reconditioning were directed for treatment, which included physical separation of organics, water and solids. Aboveground and underground storage tanks were present in this area. This area includes a former surface impoundment that was used to receive liquid wastes from the 1940's to mid-1950's.

- **Yard Area** – A 11-acre unpaved area within the southern and central portions of the Site. The Yard Area was used primarily for the storage of empty drums and contained a former staging area of incoming open head drums and a conveyor leading to Building No. 2.

- **Buildings** – A 3-acre area encompassing all former buildings with the exception of Building No.2 and the furnace courtyard (separate AOC). Drum reconditioning operations took place primarily in former Building Nos. 1, 2, 3, and 4.

- **Area North of Buildings** – A 1-acre area to the north of the buildings containing the site entrance. A majority of the ground surface is asphalt pavement. This area was not reported to have been used in drum reclamation operations.

- **Storm Water Sewer Collection System** - Consists of eight storm water catch basins and associated pipelines located along the east and southeastern property border adjacent to the NJ Turnpike. Catch basins receive runoff from the former Wastewater Treatment Area, the Yard Area, and the paved area north of the buildings. The catch basins in the Yard Area are connected to pipelines that appear to lead to the east/northeast below the NJ Turnpike. The other catch basins appear to be connected to a pipeline that leads to the north of the Site. As noted previously, these are storm sewers are the subject of additional investigation.

- **Ground Water** - Ground water beneath the site has been impacted at some of the AOCs. Currently there are fifteen monitoring wells that are used to evaluate ground water quality. Fourteen wells monitor shallow ground water and one well monitors deep ground water just above bedrock.

2.4 SOIL QUALITY

The following subsections summarize the soil quality for each area of concern. Figures 2-6 through 2-12 illustrate approximate soil distributions of PCBs, dioxins/furans, pesticides, VOCs, semi-volatile organic compounds ("SVOCs"), total petroleum hydrocarbons ("TPH"), and metals, respectively, based on the soil sample data, average concentrations, and distribution of historic fill. A more detailed description of soil quality by area of concern is provided in the January 17, 2005 *Remedial Investigation Report.*

2.4.1 Furnace Courtyard

PCBs are detected at concentrations greater than NJ Non-Residential Direct Contact Soil Cleanup Criteria ("NRDCSCC") of 2 mg/kg throughout the Furnace Courtyard to depths up to 4 to 6 feet. Concentrations greater than 500 mg/kg were detected in shallow soil at two locations. VOCs that exceed NRDCSCC include benzene, ethylbenzene, xylenes, tetrachloroethene, and trichloroethene. Elevated concentrations are detected at locations in the northern half of the Furnace Courtyard. The vertical extent of VOCs exceeding NRDCSCC is approximately 5 feet. Low concentrations of dioxins and pesticides were detected in this area. Metals in excess of NRDCSCC include arsenic, lead, copper, cadmium and zinc. SVOCs in excess of NRDCSCC included PAHs and bis(2-

ethylhexyl) phthalate. The historic fill contributes significantly to the elevated metal and PAH concentrations. Total petroleum hydrocarbons also exceed NRDCSCC at some locations. The TPH, Metals, and SVOCs exceeding NRDCSCC are limited to the fill or upper organic clay/meadow mat layer.

2.4.2 Wastewater Collection and Treatment System

The RI sampling results indicated limited impact to soil quality along many of the components and pipelines of the collection and treatment system with the exception of the Wastewater Treatment Area and locations beneath floor troughs located in Buildings No. 1, No. 3 and No. 7. Concentrations of PCBs, pesticides, toluene, and/or TPH are in excess of NRDCSCC in these areas. Two locations along the discharge pipeline in the northern portion of the Site contained PCBs in excess of NRDCSCC.

2.4.3 Storage Tank Area

PCBs concentrations greater than the NRDCSCC of 2 mg/kg are present at most areas of the Storage Tank Area including locations along the western site boundary. Elevated concentrations ranging from greater than 100 mg/kg to 450 mg/kg are present in this area. Concentrations generally are less than the NRDCSCC at depths of 3 to 6.5 feet in the wastewater treatment area and at 5 to 9 feet at the former surface impoundment.

Concentrations of pesticides greater than the NRDCSCC occur throughout most of the Storage Tank Area including locations along the site boundary. The pesticides exceeding NRDCSCC include aldrin, dieldrin, 4,4'-DDD, 4,4'-DDE, and heptachlor. The vertical extent of concentrations greater than NRDCSCC ranges from approximately 5 to 7 feet at most locations.

Concentrations of benzene and xylenes were detected at concentrations exceeding NRDCSCC at the former surface impoundment. The vertical extent is approximately 6 to 7 feet in this area. TPH was detected at concentrations greater than 10,000 mg/kg at some locations. Two samples that were collected from the former surface impoundment had indicated greater than 200,000 mg/kg of TPH, however, separate phase product was not observed at these locations. The vertical extent of the TPH greater than 10,000 mg/kg is approximately 5 to 7 feet.

Dioxins/furans are detected at low concentrations ranging from 0.4 to 7.6 ppb. Metals in excess of NRDCSCC include lead, antimony, arsenic, beryllium, cadmium, copper, and zinc. SVOCs in excess of NRDCSCC primarily are PAHs. The historic fill contributes significantly to the elevated metal and PAH concentrations.

2.4.4 Yard Area

Surface soil (0 - 2 ft) PCB concentrations at most sample locations within the Yard Area exceed the NRDCSCC of 2 mg/kg, and a majority of the surface soil contains PCB concentrations greater than 10-25 mg/kg (Figure 2-6). The areas of highest PCB concentrations (> 500 mg/kg) are located within the southern portion of the Yard Area where levels as high as 1,500 mg/kg to 3,500 mg/kg are present. PCB concentrations at the site boundary exceed the NRDCSCC. PCBs exhibit a steeply decreasing vertical concentration gradient at most locations within the Yard Area. Concentrations decrease to less than 10-25 mg/kg by depths of 2 feet at many locations where elevated surface concentration are present. The NRDCSCC (2 mg/kg) is generally achieved at depths between 3 to 6 feet. PCBs are not detected in native soil underlying the fill at most locations.

Most of the PCDD/PCDF congeners detected in the Yard Area include the Hepta- and Octa-CDDs (dioxin) and the Tetra-, Penta-, Hexa-, Hepta-, and Octa-CDFs (furans). Dioxin/furan concentrations in surface soil exceed 1 ppb TEQ at most sample locations. Concentrations greater than 20 ppb TEQ generally are present within the southern portion of the Yard Area and tend to be co-located with elevated PCB concentrations (Figure 2-7). Levels of up to 900 ppb TEQ are detected in this area. Dioxin/furan concentrations greater than 1 ppb TEQ also are present along the entire perimeter of the Yard Area with portions of the eastern and western perimeters containing concentrations greater than 20 ppb TEQ. As with PCBs, dioxin/furan concentrations exhibit a steeply decreasing vertical gradient from the surface. In the areas of elevated concentrations, levels are less than 20 ppb at depths between 1.5 to 2.5 feet. Dioxins/furans are not detected in native soil beneath the fill layer.

Pesticide compounds aldrin, dieldrin, and heptachlor are detected at concentrations exceeding the NRDCSCC at and surrounding the location of the former drum conveyor. Concentrations are less than 3 mg/kg. Dieldrin concentrations marginally exceeding NRDCSCC extend at least 100 feet east and west of the drum conveyor. Pesticide concentrations are less than NRDCSCC at depths of approximately 5 to 9 feet.

VOCs (benzene and xylenes) exceed NRDCSCC at one sample location at the former drum conveyor. The vertical extent is approximately 5 feet. TPH levels exceeding 10,000 mg/kg were detected at some locations in the Yard Area. The vertical extent of the elevated TPH is estimated to be approximately 4 feet. Historic fill-related contaminants including PAHs and metals exceed NRDCSCC throughout the Yard Area. PAH and metal concentrations are less than NRDCSCC beneath the fill layer.

2.4.5 Building Area

Sampling performed during the RI in the Building Area primarily was related to the investigation of floor troughs and pipelines that are located in or beneath Buildings 1, 3, 4, 6, and 7. Prior site investigations indicated PCBs exceeding NRDCSCC beneath or adjacent to Buildings 1, 5, 7 and 8. PCBs greater than 10-25 mg/kg are present at a few locations underlying Building 1. Metals (e.g. lead, arsenic, copper, zinc) and PAHs were detected in excess of NRDCSCC in the ash fill underlying the buildings.

2.4.6 Area North of the Buildings

Low levels of PCBs were detected at the site boundary sample locations of this area. Concentrations are less than the NRDCSCC at most locations. PCBs were not detected at the inner locations of this AOC. Dioxin/furan concentrations are less than 1 ppb or less than detection limits. Therefore, there is limited impact to soil quality in this area.

2.4.7 Storm Water Sewer Collection System

Many of the contaminants that exceed NJ NRDCSCC in soil at the Yard Area and Storage Tank Area are also found in the sediment of the catch basins, including PCBs, lead, benzo(a)pyrene, and dioxins/furans.

2.5 GROUND WATER QUALITY

Site ground water is also an Area of Concern. Fifteen monitoring wells were sampled during the RI to investigate the presence of PCBs, pesticides, VOCs, SVOCs, and metals. PCBs and pesticides were not detected in ground water samples. Background or upgradient monitoring wells do not indicate the presence of organic contaminants of concern in excess of NJ Class IIA Ground Water Quality Standards ("GWQS"). Volatile organic compounds and/or SVOCs exceed GWQS at the Furnace Courtyard, the Storage Tank Area, the eastern Yard Area, and at the extreme northeast corner of the Site. Some metals (i.e. arsenic, lead, antimony) exceed GWQS at one or more upgradient wells or wells located in areas of concern. Free phase has not been detected in ground water. A summary of the results by area is provided below, and results are shown in Figure 2-13.

Furnace Courtyard

Monitoring well FCA MW-1 monitors ground water quality in this area. VOCs were detected in excess of GWQS and include benzene, tetrachloroethene, trichloroethene, 1,1,2-trichloroethane, and methylene chloride. These VOCs are detected at comparatively low concentrations ranging from 6 to 18 ug/L.

Storage Tank Area

Four wells are located in this area. Wells BBD-C5 and BBD-C3 monitor shallow and deep zones, respectively, at the wastewater treatment area. Well UST MW-1 monitors the former UST area, and well LBMW-3 monitors shallow ground water quality downgradient of the northern Storage Tank Area. Contaminants of concern exceeding GWQS include benzene in wells BBD-C5 (7 ug/L) and BBD-C3 (13 ug/L), lead in BBD-C5 (41 ug/L) and arsenic in LBMW-1 (14 ug/L) and UST-MW-1 (44.9 ug/L).

Yard Area

Six wells are located in the Yard Area and monitor shallow ground water quality. Organic contaminants of concern detected in excess of GWQS include benzene in wells MW-A (300 ug/L) and # 2614909-5 (390 ug/L), 2,4-dimethylphenol in MW-A (22,000 ug/L) and benzo(a)anthracene (27 ug/L) and chrysene (24 ug/L) in MW-A. These wells are located at the downgradient portion of the Yard Area. Metal contaminants of concern detected in excess of GWQS include arsenic in BBD-C1 (14.8 ug/L) and BBD-C4 (10.9 ug/L), which are located in the southwestern portion of the Site at upgradient locations.

Northern Area

Four monitoring wells are located at locations north of the building. Wells BBD-C2, FCA-MW-2 and LBMW-2 are positioned at hydraulic upgradient areas of the Site. LBMW-1 is located at the northeastern most corner. Organic contaminants of concern in excess of GWQS were detected only in well LBMW-1 and included benzene (4 ug/L), naphthalene (600 ug/L) and 2-methylnaphtalene (640 ug/L). Metal contaminants of concern in excess of GWQS are antinomy in BBD-C2 (62 ug/L) and arsenic in LBMW-2 (22.6 ug/L).

2.6 BASELINE ECOLOGICAL EVALUATION

A baseline ecological investigation ("BEE") was performed during the Remedial Investigation. The BEE identified three on-site sources containing chemicals of potential ecological concern ("COPECs") which include surface soils, sediment in catch basins, and ground water. COPECs exceeding benchmark values include PCBs, pesticides, dioxins/furans, metals, VOCs, SVOCs, and TPH. No environmentally sensitive areas ("ESAs") or resources, such as wetlands or surface water, were identified at the Site. Therefore, COPECs in soil, sediment, and ground water do not represent a concern from an on-site ecological perspective. Off-site ESAs in the vicinity of the Site include the Passaic River and drainage ditches/basins with wetland characteristics that are located east (including the Harrison Ditch) and northeast of the Site and are adjacent to major roadways and industrial areas. No surface water connection currently appears to exist between the Site and the off-site ESAs, but is the subject of further investigation. The only potential migration pathway for COPECs appears to be ground water, which flows to the east/southeast from the Site toward the wetland/ditches located to the east of the Site across the NJ Turnpike. Therefore, this downgradient off-site ESA may be adversely impacted by migration of impacted ground water. This off-site ESA is impacted by other point and non-point discharges from the Turnpike and surrounding industrial properties. Historic surface water discharge from the Site to the Harrison Ditch appears to have existed from the early 1940's to the late 1960's based on historic aerial photographs and historic information.

3.0 REMEDIAL ACTION OBJECTIVES

This section describes the remedial action objectives for Site remediation based on a conceptual reuse plan for the Site. The remedial action objectives ("RAOs") have been developed to control Site contamination and to eliminate the potential for exposure of human and ecological receptors to Site contamination based on the conceptual reuse plan. The redevelopment plan will be integrated into the selected remedy for the Site. The following subsections describe the conceptual Site redevelopment plan, applicable remediation levels, potential receptors and exposure pathways based on future site use, and the specific remedial action objectives for soil, ground water, and sediment.

3.1 CONCEPTUAL SITE REDEVELOPMENT AND USE

Conceptual site redevelopment is for non-residential use and will be compatible with redevelopment under a commercial use setting or the Portfields Initiative. The City of Newark has contracted a redeveloper, BayBar Redevelopment, LLC, who has committed to develop the property for commercial/light industrial use immediately upon completion of the remedy. The Site's redevelopment plan has not been finalized. For purposes of this RASR, a conceptual redevelopment plan is presented that is consistent with preliminary redevelopment plans contemplated for the Site and considers the inherent limitations such as points of access and existing easements. The conceptual plan includes a large building (e.g. large retail store or warehouse) with associated parking lots, paved loading/unloading areas, access roads, and other associated features (Figure 3-1). The conceptual plan meets the zoning classification for this area (Third Industrial District I-3), which allows for a variety of industrial/commercial uses. All major utilities are available in sufficient capacity to support redevelopment including sanitary sewer, public water, natural gas, and electric service. Storm water can be managed on-site by a storm water detention basin in accordance with current regulations and ordinances.

The purpose for developing this conceptual site redevelopment plan is to present the feasibility of integrating the remediation of the site within the framework of a reasonable future use scenario for the site. The following summarizes features of the conceptual development.

<u>Site Access/Exit</u>

The conceptual redevelopment plan anticipates that primary site access and exit will be at the south west corner of the property via an access road from Foundry Street, which is located approximately

850 feet south of the Site. A secondary entrance/exit is located at the northwest property corner and leads to Truck Route 1 and 9.

Building

The Site can accommodate a building up to approximately 300,000 square feet. The size of the building will be controlled by various factors including storm water management, building coverage allowed by zoning, vehicle access and geotechnical considerations. The presence of the underground natural gas transmission lines provides limitation on the location of the building. The size of the building shown in the conceptual plan is approximately 223,000 square feet. The building will be surrounding by asphalt-paved road way.

Parking Areas

The conceptual site redevelopment plan shows asphalt parking lots located south and southwest of the building and encompassing approximately 100,000 square feet.

Gas Transmission Pipeline Easement

The conceptual development plan will maintain the integrity of the natural gas transmission pipelines that traverse the site from south to north and will allow for unobstructed access for future pipeline maintenance. Asphalt paved roadways or parking areas will overlie the gas line easement.

Underground Utilities

The conceptual site development plan provides that underground utilities for the development (natural gas, electrical, water supply, sanitary sewer, and storm water) will be located during redevelopment within clean utility corridors.

Storm Water Detention Basin

Storm water will be collected and managed on site using a storm water detention basin that will be constructed in accordance with NJ Storm Water Regulations, or by other options that may be developed by the site redeveloper in accordance with applicable regulations and ordinances. The detention basin would be approximately one acre in size and located at the north end of the property.

3.2 RECEPTORS

Potential future receptors and potential exposure pathways of chemicals of concern (COCs) present in Site media are described in this subsection. Potential future receptors are dictated by the future redevelopment of the Site as discussed above. Exposure pathways are means by which COCs move through the environment from a source to a point of contact with a receptor. A complete exposure pathway has: (1) a source of COCs, (2) a mechanism for transport of a COC from the source to the air, surface water, groundwater and/or soil, (3) a point where a receptor comes in contact with COCs in air, surface water, groundwater or soil, and (4) a route of entry into the receptor. If any part of an exposure pathway is absent, the pathway is incomplete and no exposure or risk is possible. Receptors and pathways to each potential media of concern at the Site are summarized below. A more detailed evaluation of potential human health receptors is provided in the Focused Human Health Risk Assessment (Appendix A).

3.2.1 Soil

The COCs in soil exceeding soil cleanup criteria include PCBs, dioxins/furans, pesticides, VOCs, SVOCs, and metals (See Table 3-1). The historic fill at the site contributes to the presence of COCs such as PAHs and metals. PCBs and dioxins/furans are considered to be principal soil COCs based on distribution and concentration.
The potential receptors to soil COCs based on the future use scenario are:

- employees
- site visitors
- post-remedy utility workers
- environmental receptors (biota)
- ground water

The potential exposure pathways of soil COCs based on the future site use include: 1) direct dermal contact/soil ingestion; 2) inhalation of air borne particulates; 3) migration of soil vapors (vapor intrusion in building or utility man ways) and vapor inhalation; 4) migration of soil particulates via storm water erosion and impact to environmental receptors; and 5) percolation and migration of soil COCs to ground water ok!

3.2.2 Ground Water

The chemicals of concern in ground water that exceed NJ Class II-A GWQS include VOCs, SVOCs, and metals that may migrate off-site and impact potential receptors (See Table 3-2). The presence of a potable ground water use receptor was not identified during the RI. A well search conducted during the RI did not identify any ground water use wells or potable wells within ½-mile and one mile of the Site, respectively. In addition, the City of Newark does not utilize ground water as a potable water source. Water is entirely from surface sources in the Pequannock and Wanaque watersheds that cover 150 square miles of forestlands in Morris, Sussex and Passaic Counties.

The only receptors to Site ground water are off-site surface water body receptors and utility workers that may encounter ground water during future post-redevelopment work activities. The BEE performed during the RI identified surface water bodies located approximately 800 ft to 1,800 ft east and northeast of the site as potential receptors of ground water COC migration from the Site. These receptors include the Passaic River and drainage ditches/basins with wetland characteristics. There are also numerous other potential contaminant sources for these same receptors.

3.2.3 Sediment in Storm Water Catch Basins

Totally incomplete

Chemicals of concern identified in sediment of the storm water catch basins include PCBs, dioxins/furans, SVOCs, and metals. See Table 3-1. While based on the BEE there does not appear to be a current surface water body receptor for COCs in sediment of the existing storm water catch basins, this is a subject of further investigation. Ground water is identified as the only potential receptor for this media via migration of sediment COCs to ground water.

DRAINAGE DIAGRAMS PROVIDED BY NJ TURNPIKE SHOW DIRECT DISCHARGE TO PASSAIC RIVER @ TWO LOCATIONS

3.3 REMEDIAL ACTION OBJECTIVES AND ACTION LEVELS

This subsection provides the remedial action objectives (RAOs) for soil, ground water, and sediment. The remedial objectives are designed to provide protection of human health, safety, and the environment and address potential receptor exposures to COCs and potential migration pathways.

3.3.1 Soil Remedial Action Objectives

The following remediation criteria and guidance will be used to evaluate the selection of remedial action objectives.

1. NJDEP Non-Residential Direct Contact Soil Cleanup Criteria (a.k.a. restricted use~~d~~ soil cleanup criteria) for all COCs. Based on the industrial zoning of the site, as well as the presence of major highways such as the NJ Turnpike and Routes 1 and 9, the use of the restricted use soil cleanup criteria is appropriate.

2. USEPA's PCB preliminary remediation goal (PRG) 10 – 25 mg/kg for direct contact at commercial/industrial properties and recommended principal threat waste remediation goal of

greater than or equal to 500 mg/kg of PCBs at commercial/industrial properties.[1] A principal threat waste is defined as source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.

100 – 500?

3. USEPA's regulations under CFR 40 761.61 regarding remediation of bulk PCB remediation waste. Under this regulation, the *Self-Implementing Disposal Option* (§761.61(a)) permits capping of soil containing PCBs in concentrations > 1 mg/kg to ≤ 10 mg/kg for a high occupancy area (an average of 6.7 hours or more per week of occupancy) and > 25 mg/kg to ≤ 100 mg/kg for a low occupancy area (less than 6.7 hours per week of occupancy). *The Risk Based Disposal Option* (§761.61(c)) permits a risk-based method for PCB remediation. An application must be submitted to the Regional USEPA Administrator. The Administrator can approve the application if the method will not pose an unreasonable risk of injury to health or the environment based on a site-specific risk assessment.

4. USEPA PRG for dioxins/furans of 5 – 20 ppb (TEQ) in surface soil at commercial/industrial properties.[2]

The NJDEP permits the use of institutional and engineering controls as a remedial action allowing concentrations of COCs in excess of restricted use cleanup criteria to remain in place. Institutional controls restrict certain uses of the property and are implemented through a deed notice to the property. The deed notice provides information regarding the spatial extent of soil contamination above the applicable soil cleanup criteria and information regarding engineering controls. Engineering controls are physical mechanisms (e.g. cap or fence) to contain or stabilize contamination and control exposure to the contamination. Institutional and engineering controls shall remain protective of public health and safety and the environment as long as contamination exists above the applicable cleanup criteria. The future use of the site shall be consistent with all institutional and engineering controls. The TRSR (N.J.A.C. 7:26E-8.1) provides the requirements for use of engineering and institutional controls.

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[1] USEPA August 1990. *A Guide on Remedial Actions at Superfund Sites with PCB Contamination.*

[2] USEPA April 13, 1998. *Approach for Addressing Dioxin in Soil at CERCLA and RCRA Sites*. OSWER Directive 9200.4-26.

The remedial action objectives identified for soil are:

1. Control the direct contact (dermal contact/soil ingestion) pathway for future potential receptors at the site.

2. Control the exposure of future potential receptors to migration of organic vapors from VOCs/SVOCs in soil.

3. Control the transport of COCs from soil to ground water.

4. Control potential surface water erosion and fugitive transport of COCs within surface soil.

3.3.2 Ground Water Remedial Action Objectives

Despite the absence of ground water use receptors, the Class IIA Ground Water Quality Standards ("GWQS") will be used as guidance for assessing the remediation of ground water per the requirements of the TRSR.

The remedial action objectives for ground water are:

1. Control the potential for ground water COCs to migrate to downgradient surface water bodies.

2. Reduce concentrations of COCs to ultimately reach Class IIA GWQS.

The NJDEP TRSR (N.J.A.C. 7:26E-6.3) permits natural ground water remediation of COCs in excess of GWQS when free phase product is not present, when the effectiveness of natural remediation can be demonstrated via a monitoring program, and when receptors to Site ground water are not impacted. The NJDEP requires a Classification Exception Area ("CEA") when GWQS are exceeded in an area. CEA's are institutional controls of geographically defined areas and durations within which the NJ Class IIA GQWS for specific COCs are exceeded. When a CEA is designated for an area, the constituent standards and designated aquifer uses are suspended for the term of the CEA.

3.3.3 Catch Basin Sediment Remedial Action Objectives

As there are no on-site environmentally sensitive areas impacted by sediment in the existing catch basins, the soil remediation criteria are used to assess the remediation of sediment.

The remedial action objectives identified for sediment are:

1. Eliminate the direct contact (dermal contact/soil ingestion) pathway for future potential receptors at the site.

2. Reduce the migration of COCs from soil to ground water.

3. Reduce potential surface water erosion and fugitive transport of COCs within the sediment.

4.0 SELECTED REMEDIAL ACTION

This section identifies, describes, and evaluates the selected remedial action for the Site that will provide long-term protection of public health, safety and the environment and that can effectively meet the remedial action objectives presented in Section 3.0. The selected remedial action is evaluated against the criteria appearing in N.J.A.C. 7:26E-5.1 (TRSR) that are used to assess the protectiveness and the implementability of the selected remedial action. A focused human health risk assessment ("FRA") that used site-specific human health criteria was prepared to evaluate the proposed remedy. The FRA demonstrates that the proposed remedy does not present an unreasonable risk to human health and safety for post-remedy conditions at the Site.

4.1 SOIL / SEDIMENT REMEDIAL ACTION

The primary objectives for the remedial action of soil and sediment are to control exposure of soil COCs to future site receptors and limit transport of COCs in surface soil and to ground water. The remedial action selected to achieve these remedial action objectives includes a combination of removal and containment methods as described below.

4.1.1 Excavation and Off-Site Disposal

Excavation and off-site disposal of PCBs ≥ 500 mg/kg will be performed to remove principal threat waste. This measure has the added effect of removing the highest concentrations of dioxins/furans. Based on existing sample data, the estimated volume to be excavated is up to 6,000 cubic yards. Soil will be excavated to depths of 1.5 to 2 ft in most locations in the Yard Area where PCBs are > 500 mg/kg. Deeper excavation will occur within the Furnace Courtyard ? where PCBs have been detected at concentrations > 500 mg/kg at depths of 3 to 4 feet PTE removal will result in a reduction of the total PCB and dioxin/furan-TEQ soil concentrations to a 99% Upper Confidence Limit mean concentration of 66.6 mg/kg of PCBs and 13.5 ug/kg of dioxin/furan-TEQ (see FRA in Appendix A). Additionally, two hot-spot areas of lead at sampling locations FCA-7 (172,000 ug/kg) and YA-20 (198,000 ug/kg) will be investigated for removal.

4.1.2 Cleaning of Remaining Waste Water Pipelines

Cleaning of remaining waste water system pipelines will be performed to remove remnant waste material as a potential source to ground water. Remaining waste water pipelines are located beneath the floor slab to Building No. 1 and north of Building No. 1.

4.1.3 Engineered Cap

NOT PROTECTIVE of GW AND VIA MIGRATION GW

The selected remedy provides for capping of historic fill and the remaining soil with COCs exceeding Non-Residential Direct Contact Soil Cleanup Criteria. The cap will have a minimum thickness of two feet and will consist of clean soil cover and site redevelopment structures such as building slabs and asphalt pavement as provided in the Conceptual Redevelopment Plan shown in Figure 3-1. As noted earlier, all utilities associated with redevelopment will be placed in clean corridors. The cap will control direct contact and exposure to underlying soil COCs, will control surface water transport of COCs in surface soil, and limit surface water infiltration and transport of COCs to ground water.

In addition to the engineering and institutional controls contemplated for the selected remedy, additional enhancements could include installation of a separating barrier (e.g., geotextile, hi-vis fence layer); additional soil cover, and; consolidation of selected soils. The Remedial Action Work Plan will incorporate enhancement integrated with the redeveloper's site plan, and will include a Soil Reuse Plan to account for necessary site grading and subgrade construction.

4.1.4 Mitigation of VOCs Vapor Intrusion

The building design will incorporate a vapor barrier or venting system to mitigate potential vapor intrusion into the building. This remedy shall meet the objective of controlling the exposure of future potential receptors at the site to migration of organic vapors from VOCs/SVOCs in soil or ground water.

4.1.5 Storm Sewer System Abandonment

Further investigation of the storm sewer system is planned to identify potential off-site discharge locations. As part of this investigation, additional characterization of the sediment within the catch basins will be performed, and the sediment in catch basins will be removed and properly disposed. The on-site storm sewer system will be abandoned and properly closed to mitigate any potential off-site transport of sediment COCs.

4.1.5 Deed Notice

A Deed Notice will be prepared and recorded for the remedial action. The Deed Notice will identify post-remedy site conditions and institutional controls including the following information.

1. The types, concentrations and spatial extent of COCs in excess of Residential Direct Contact Soil Cleanup Criteria.

2. The engineering controls applicable to the property.

3. The specific use restrictions to the applicable property due to contamination including a non-residential use limitation and procedures for proper handling of contaminated soil and implementation of health and safety control measures if impacted soil is disturbed during future site work and/or maintenance of cap.

4. Maintenance and monitoring procedures of the Deed Notice including biennial certifications certifying: that periodic inspections of the engineering controls were performed and cap integrity continues to be protective; that land use is consistent with use restrictions; and that any disturbance that has taken place within the restricted area enumerated in the deed notice do not, or did not present an unacceptable risk to the public health and safety or the environment.

The Deed Notice will be prepared pursuant to N.J.A.C. 7:26E-8.0 (TRSR).

4.1.6 Integration with the Final Redevelopment Plan

The design of the soil remedial action will be integrated and coordinated with the design of the final Site redevelopment plan. The final design of the cap and surface water management/erosion controls will incorporate the final redevelopment design layout, including final grades and the locations of the building, roads, parking area, utilities, detention basin, and landscaping. The Soil Reuse Plan will provide for consolidation of impacted soils excavated during redevelopment.

4.1.7 Monitoring and Maintenance of Engineering and Institutional Controls

A plan for the maintenance and evaluation of all engineering and institutional controls will be prepared pursuant to N.J.A.C. 7:26E-8.5 (institutional controls) and 8.7 (engineering controls), as applicable. The plan will meet the requirements of the TRSR including procedures and scheduling of periodic inspections, reporting, and biennial certifications. The plan will be prepared with the RAW for the Site.

4.2 GROUND WATER REMEDIAL ACTION

The primary remedial action objectives for ground water are to control the potential for COCs in ground water to migrate to downgradient surface water bodies and to reduce COC concentrations to ultimately reach Class II A GWQS. Free phase product is not present in ground water, and there are no ground water use receptors impacted by Site ground water. The only potential receptors are environmentally sensitive surface water areas located hydraulically downgradient of the Site. In addition, the Site is within a region characterized by industrial sites and former landfills, many of which have ground water contamination in excess of Class IIA GWQS. Based on these factors, the remedial action selected to achieve the remedial action objectives is natural ground water remediation.

4.2.1 Natural Ground Water Remediation

Natural ground water remediation or natural attenuation processes include a variety of physical, chemical and biological processes that under favorable conditions will act to reduce the mass, toxicity, mobility, volume, and concentrations of COCs in ground water. These natural processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants. Natural remediation is considered to be an appropriate remedial action when it can be demonstrated to be capable of achieving the remedial action objectives in a time frame that is reasonable compared to other alternatives. The Remedial Investigation (RI) performed for the Site identified COCs in excess of GWQS that commonly are affected by natural processes, such as benzene, naphthalene, chlorinated VOCs, and metals (lead and arsenic). The Site RI, however, did not yet demonstrate that site-specific natural attenuation processes can reduce GWQS in a reasonable time frame (e.g. within 25-30 years). Therefore, activities will be performed pursuant to N.J.A.C. 7:26E-6.3d to demonstrate the effectiveness and viability of using natural remediation as a remedial action for Site ground water.

4.2.2 Ground Water Modeling

The Site RI did not delineate the downgradient off-site extent of COCs in excess of GWQS. In the NJDEP' s August 15, 2005 comment letter to the RI Report, the NJDEP stated that one condition necessary for acceptance of natural attenuation is to determine whether downgradient receptors are being impacted by Site ground water. As discussed above, the only downgradient receptor is surface water bodies located approximately 800 ft to 1,800 ft east and northeast of the Site. In lieu of ground water sampling to delineate the downgradient extent of COCs that could potentially impact surface water body receptors, a ground water transport-reaction model will be used to predict whether there may be an impact to surface water. Therefore, a ground water model will be developed to evaluate the downgradient extent of contaminated ground water migration that may reach and impact surface water receptors.

4.2.3 Ground Water Monitoring

If the ground water model predicts that surface waters bodies are not impacted by Site ground water, then a monitoring program will be developed to demonstrate the viability of natural remediation to achieve the remedial action objectives. The monitoring program will be developed in accordance to the requirements of N.J.A.C. 7:26E-6.3e (TRSR), which includes a quarterly monitoring program for a minimum of eight quarters or two years to statistically evaluate the data. The results of the quarterly monitoring will be used to demonstrate declining concentration trends, degradation rates of specific COCs, and the predicted time when GWQS will be met. The data will also be used to revise, if necessary, the predicted downgradient extent of COCs in excess of GWQS based on the modeling effort, which can be used in establishing a Classification Exception Area for the Site in conjunction with the natural remediation approach. If the effectiveness of natural remediation cannot be demonstrated to achieve remedial action objectives, then an alternative remedy will be considered.

4.2.4 Classification Exception Area

A Classification Exception Area will be established to provide restrictions on ground water use in the areas where GWQS are exceeded and to establish a duration of the term of the CEA. The CEA presents the following information:

1. The COCs in excess of GWQS;

2. The vertical and horizontal extent of the CEA with the boundary provided in GIS format;

3. The expected rate of improvement of ground water quality and a time frame for ground water to meet GWQS; and

4. The specific use restrictions of ground water within the CEA boundary area.

The CEA will be monitored and maintained in accordance with the requirements of the CEA.

4.3 CONSISTENCY WITH OTHER SITE REMEDIES

The selected remedy is consistent with NJDEP and USEPA-approved remedies recently selected for other sites located in New Jersey that contain elevated PCB concentrations including the Cornell-Dubilier Electronics, Inc. Superfund Site located in South Plainfield, New Jersey and Hatco Corporation (Hatco) site located in Fords, New Jersey. The approved remedy at the Hatco site provides for excavation and removal of all soil containing more than 500 mg/kg of PCBs and on-site containment of soils with residual PCB concentrations to remain on-site beneath an engineered cap. The engineered cap will consist of soil cover, pavement, and existing development structures such as buildings, pads, and tank farms. Similarly, the selected remedy for the Cornell-Dubilier site includes excavation of soils with PCBs greater than 500 mg/kg and capping of soils with greater than 2-10 mg/kg of PCBs using site structures, parking areas, and walkways.

5.0 EVALUTION OF SELECTED REMEDY

This section presents an evaluation of the selected remedial action with respect to evaluation criteria appearing in N.J.A.C. 7:26E-5.1(c) (*Remedial Action Selection*) and incorporates the results of a Focused Human Health Risk Assessment ("FRA"), which assesses the protectiveness of the selected remedy under post-remedy/post-redevelopment conditions.

The evaluation criteria assess whether a remedial action will reduce or eliminate exposure to COCs above the applicable remediation criteria, and, consequently whether it will be protective of human health and the environment. The evaluation criteria include:

- **Protection of Public Health and Safety and the Environment**, including
    a. technical performance and effectiveness in attaining compliance with remedial objectives.
    b. reliability in maintaining compliance with remedial objectives.
    c. reduction of toxicity, mobility, or volume
    d. minimization of risks and short-term impacts associated with implementation of the remedy while providing long-term protection
    e. mitigation of off-site migration through erosion, subsurface migration or other migration pathways.

- **Implementability,** including
    a. feasibility and availability of the technologies utilized in the remedial action
    b. completion of the remedy within a reasonable time frame .
    c. property owner's written agreement to the implementation of the remedy

- **Consistency with applicable Federal, State, and local laws and regulations.**

- **Potential impacts on the local community**

- **Potential to cause natural resource injury**

The following subsections provide the evaluation for the selected remedial action for soil and ground water and summarize the results of the FRA. The results of the evaluation indicate that the selected remedial action satisfies all evaluation criteria. The results of the FRA indicate the proposed remedy is protective and does not present an unreasonable risk to human health under post-development conditions.

5.1. EVALUATON OF SOIL/SEDIMENT REMEDIAL ACTION

5.1.1 Protectiveness of Human Health and the Environment

Protectiveness

The selected remedy is protective of public health and safety and the environment and provides long-term protection against exposure to contaminated soil as long as the integrity of the engineering controls (cap and vapor mitigation system) is maintained. Potential human health risks are reduced through removal of principal threat PCB concentrations and co-located dioxins/furans and other COCs. Future potential direct contact exposures to remaining COCs will be effectively eliminated via the engineered capping of the Site, which is anticipated to include soil cover and the construction of permanent physical structures (e.g. pavement, buildings) associated with the Site redevelopment plan. The capping elements also will be effective in containing and controlling potential transport of Site-related COCs via erosion pathways, and abandonment of the existing storm sewer collection system will eliminate any `potential pathways to ecologically sensitive areas. The vapor barrier/venting system will prevent exposure to vapor intrusion in buildings. Placement of Site utilities in subsurface clean corridors will minimize exposure to contaminated soil during future maintenance activities. Institutional controls established via a Deed Notice will minimize exposure to soils by restricting use of the Site and providing knowledge of Site conditions and proper notifications to allow for proper handling of contaminated soil and appropriate health and safety control measures during future maintenance or construction activities. Periodic inspections that will be required in the Deed Notice will enable detection of any damage to the cap structures such that appropriate repairs can be made. Biennial certifications will ensure that land use is consistent with applicable use restrictions and the integrity of the cap is maintained and continues to be protective.

Reliability and Technical Performance and Effectiveness

The selected remedial action relies on fully demonstrated technologies of removal and containment that are technically feasible, reliable and effective at attaining remedial goals. The remedial action objectives will be achieved following completion of construction activities.

The remedy reduces long-term risks because highly contaminated soils containing elevated PCBs (> 500 mg/kg) and co-located dioxins/furans would be removed. Off-site disposal of the highly contaminated soils at a permitted hazardous waste facility is reliable because such facilities employ safeguards that ensure the security of the waste material. Since the integrity of the engineering controls will be maintained, the remedy will provide long-term effectiveness and permanence in the protection of human health, safety and the environment. The Deed Notice will restrict future site use and provide procedures/controls for future site maintenance activities that further reinforce the permanence of the remedy.

Reduction in Toxicity, Mobility, or Volume

The selected remedial action will greatly reduce the mobility of Site-related COCs in soil by the removal of principal threat waste soils and by the capping of surface soils. The cap structures will prevent physical transport via surface water runoff/erosion and fugitive dust. In addition, the hardscape elements of the cap (building, asphalt pavement, walkways) will limit infiltration of precipitation and reduce the potential mobility or leaching of COCs to ground water. The excavation and off-site disposal of principal threat soils will reduce the toxicity, volume and mobil contaminants on site by removal and treatment at an approved disposal facility.

Minimization of Short-Term Risks or Impacts

Implementation of the soil remedy may present short-term risks because of th exposure (e.g. dust, VOCs) associated with soil excavation, handling, grading and transp he potential for short-term exposures during implementation of the remedy will be controlled by application of appropriate and conventional health and safety measures such as worker personal protective equipment and monitoring, minimization of the generation of fugitive dust, soil erosion and sediment control measures, and other protective measures that will be developed in a Remedial Action Workplan/Health and Safety Plan for the Site remediation. When properly implemented, the selected remedial action would not result in any unacceptable short-term risks and impacts to public health, safety and the environment.

Mitigation of Off-Site Migration

The cap will reduce or eliminate the potential for migration of COCs off-site via surface erosion and will reduce the infiltration of surface water and leaching potential of contaminants in areas with low permeable hardscape cap materials (i.e. asphalt, concrete). Abandonment of the existing storm water sewer system will eliminate a potential off-site pathway via the storm sewer system. The proposed storm water detention basin will be constructed with clean fill to prevent erosion or storm water infiltration in contaminated soil/historic fill.

5.1.2 Implementability

Feasibility and Availability of Remedial Technologies

The proposed remedy is both technically and administratively feasible. The labor, equipment and materials needed to implement the remedy are conventional, readily available, and standard in the industry. The cap system can be easily designed to meet specific land use needs dictated by the redevelopment plan. Treatability, bench scale or pilot studies are not required for the design and implementation of the soil remedy. Permitted waste disposal facilities (incinerators, landfills) are available that can accept the planned excavated principal threat waste soils that contain a mixture of PCBs, dioxins/furans, metals (e.g. lead) among other COCs and that may be classified as a characteristic hazardous waste. Therefore, off-site soil disposal is feasible. During remedial activities that could result in exposure to COCs, personnel required to implement the remedial activity would require Occupation Safety and Health Administration (OSHA) certifications (e.g. hazardous waste worker). Such workers are readily available. There are no ecologically sensitive areas on site that would prevent or limit implementation of the selected remedy.

Completion Within a Reasonable Time Frame

The proposed remedy integrated into site redevelopment can be completed within the five year time frame established in the TRSR following the Remedial Action Workplan ("RAW") approval Principal threat waste excavation and remnant pipeline removal can be completed within one year of the RAW approval.

Property Owner Consent

The property owner (City of Newark) has accepted the selected soil remedial action including the engineering control (cap) and the application of institutional controls including non-residential use restrictions.

5.1.3 Consistency with Applicable Regulations

The selected remedy can be implemented in a manner that is consistent with applicable federal, state, and local laws and regulations, including:

- Toxic Substances Control Act ("TSCA"):
  - Requirements codified at 40 CFR 40 CFR §761.61 providing for a risk-based disposal approach for managing bulk PCB remediation wastes.
  - Requirements codified at 40 CFR §761.65 governing storage for disposal of PCB waste with concentrations greater than 50 mg/kg.
  - Requirements at 40 CFR §761.79 setting decontamination standards for equipment and personal protective equipment.
- Resource Conservation and Recovery Act ("RCRA"):
  - Requirements codified at 40 CFR Part 262 governing packaging, labeling, manifesting, and storage of hazardous waste.
  - Requirements codified at 40 CFR Part 263 governing off-site transportation of hazardous waste.
  - Requirements codified at 40 CFR Part 264 governing the on-site storage of hazardous waste.
  - Requirements codified at 40 CFR Part 268 governing Land Disposal Restrictions of hazardous wastes.
- Hazardous Materials Transportation Law, 49 U.S.C § 5101 et seq. – hazardous wastes that are transported off-site must meet Department of Transportation regulations set for in 49 CFR Parts 105, 107, 171-178.
- Clean Water Act ("CWA") – Section 402 of the CWA, 33 U.S.C. § 1342, and its regulations codified at 40 CFR Part 122 governing discharge of storm water from construction sites of more than one acre.
- NJDEP Technical Requirements for Site Remediation – requirements codified at N.J.A.C 7:26E setting technical standards to be followed at sites undergoing remediation pursuant to New Jersey remediation programs.

- NJDEP Department Oversight of Contaminated sites – requirements codified at N.J.A.C. 7:26C governing administrative procedures to participate in the remediation of a contaminated site.

- NJDEP Hazardous Waste Management Regulations – requirements codified at N.J.A.C. 7:26G establishing standards for generation, accumulation, on-site management, and transportation of hazardous wastes.

- New Jersey Air Quality Regulations – requirements codified at N.J.A.C. 7:27 setting standards for the generation and emission of air pollutants.

5.1.4 Potential Impact to Local Community

Implementation of the selected remedy is not anticipated to have significant adverse impacts on the local community. Remedial construction activities will be limited to the Site, with the exception of off-site transportation of excavated soils and residuals in remnant pipelines. The remedy will cause a short-term increase in truck traffic. Traffic impacts to the surrounding community should be minimal as site access and exit will be to major roadways (Route 1/9 Truck Route and NJ Turnpike). Appropriate transportation safety measures would be required during shipping of contaminated soils and materials. Noise, dust emissions, and other remedial construction activities will be controlled to minimize potential impact to the surrounding community.

Implementation of the site remedy will allow for Site redevelopment that will provide significant beneficial use for the community. The Site redevelopment will restore this under-utilized property to economic use, create jobs and enhance the tax base for the City of Newark. The remedy will increase the urban vitality of the City and reduce threats to natural resources and human health.

The remedy and conceptual redevelopment is consistent with the Master Plan for this area, which is zoned for commercial/industrial use, and is compatible and well suited for future use as a Portfields Site to support growth of the NJ/NY Port region.

5.1.5 Potential for Natural Resource Injury

The proposed remedy will mitigate the potential for natural resource injury by preventing migration of and eliminating exposure to soil contaminants via soil removal and containment. Prior removal or cleaning of waste sources (USTs, waste water treatment structures, and pipelines) along with proposed removal of remaining pipelines and abandonment of existing storm water collection system will remove further potential impacts to ground water or migration to potential off-site ecologically sensitive areas. In addition, the anticipated hardscape elements of the cap (building, asphalt pavement, walkways) will reduce infiltration of precipitation and reduce the potential mobility or leaching of COCs to ground water.

5.2 EVALUATION OF GROUND WATER REMEDIAL ACTION

5.2.1 Protectiveness of Human Health and the Environment

<u>Protectiveness</u>

Monitored natural remediation with application of a Classification Exception Area is the selected remedy for ground water. There are no current ground water supply wells in the area that could be impacted by Site ground water. The only potential receptor are downgradient surface water bodies east/northeast of the Site. Planned ground water modeling will assess the potential for impact to these surface water bodies, and a monitoring program will be developed and implemented to demonstrate the effectiveness of natural remediation as the selected remedy.

The remedy will reduce the exposure to affected ground water via a CEA, which will be established to identify the limits of impacted ground water in excess of Class IIA GWQS and to provide for restrictions (i.e. via a Well Restriction Area) for potential future ground water use in the areas where ground water quality standards are exceeded. Development of the CEA for Site ground water will be performed during development of the Remedial Action Workplan and will occur following approval of the CEA information to be submitted with the RAW. Natural remediation will protect the environment by reducing COC concentrations migrating off-site.

<u>Reliability and Technical Performance and Effectiveness</u>

Natural remediation or attenuation is a demonstrated remedial approach capable of reducing COC concentrations and limiting migration of ground water plumes. COCs in Site ground water are amenable to natural attenuation processes. Natural attenuation will permanently reduce ground water organic COC concentrations and/or change toxicity through degradation. There are no long term risks to potential users of ground water because the aquifer in this region is not used as a ground water source. Implementation of the CEA and Well Restriction Area will provide adequate long-term effectiveness during the duration of the CEA if there is future use of the aquifer as a water supply source.

Reduction in Toxicity, Mobility, or Volume

The selected ground water remedy will reduce the toxicity and volume of COCs by reducing concentrations of ground water COCs via natural attenuation processes. The soil remedy (soil removal and capping) will reduce the on-site volume of impacted soil that can potentially leach to ground water and reduce the infiltration of precipitation which will diminish the potential mobility or leaching of soil COCs to ground water that may add to the mass flux of COCs to ground water.

Minimization of Short-Term Risks or Impacts

There are minimal short-term risks associated with implementation of natural remediation. Any short-term exposures during implementation of the remedy (such as monitoring well/installation and sampling) will be controlled by application of appropriate health and safety measures. Contaminated water generated during monitoring activities will be properly disposed of in accordance with a Workplan to be developed for the monitoring program.

Mitigation of Off-Site Migration

Natural remediation will reduce COC concentrations and the downgradient extent of ground water plumes. The cap will reduce the potential for migration of COCs from soil to ground water, and consequently, reduce the COC mass flux to ground water that may add to the off-site migration of COCs.

5.2.2 Implementability

Feasibility and Availability of Remedial Technologies

Natural remediation processes are reliable and proven. Monitored natural remediation can be implemented without difficulty, requiring development of a ground water monitoring network and sampling/analysis plan. Labor, equipment and materials needed to implement the remedy are readily available. Ground water sample collection and laboratory analyses can be routinely implemented using technicians trained and/or certified in NJDEP methods. Some monitoring wells may be required to remain during or after implementation of the soil remedy and redevelopment of the Site. A Workplan will be developed that will identify the procedures for maintaining the integrity of the wells or for replacing the wells as appropriate.

Completion Within a Reasonable Time Frame

The quarterly monitoring program and evaluation can be completed within a reasonable time frame. The time during which natural remediation will reduce ground water concentrations to GWQS will be determined using the quarterly monitoring data and appropriate transport-reaction modeling.

5.2.3 Consistency with Applicable Regulations

The selected remedy can be implemented in a manner that is consistent with and meets the standards of applicable regulations including:

- NJDEP Technical Requirements for Site Remediation – requirements codified at N.J.A.C 7:26E setting technical standards to be followed at sites undergoing remediation pursuant to New Jersey remediation programs.

- NJDEP Department Oversight of Contaminated sites – requirements codified at N.J.A.C. 7:26C governing administrative procedures to participate in the remediation of a contaminated site.

- NJDEP New Jersey Water Quality Standards – requirements codified at N.J.A.C. 7:9-6 concerning ground water classification, designated uses of ground water, and ground water quality and constituent standards.

5.2.4 Community Concerns

Implementation of the selected remedy will not have significant adverse impacts on the local community. Natural remediation will improve ground water quality and achieve remedial action objectives without local community disruption.

5.2.5 Potential for Natural Resource Injury

The proposed remedy should decrease the potential for natural resource injury by isolating site-related COCs from groundwater transport and by natural remediation processes.

5.3 FOCUSED HUMAN HEALTH RISK ASSESSMENT

The Focused Human Health Risk Assessment (FRA) was separately prepared in connection with the proposed remedy/redevelopment pursuant to 40 CFR 761.61 (c) - *Risk-Based Cleanup and Disposal Option.* The FRA assesses potential post-remediation and post-redevelopment human health risks.

The risk assessment evaluated concentrations of chemicals of concern (COCs) in soil and ground water, the exposure pathways and exposure point concentrations to human health receptors for the future use of the Site; and the protectiveness of human health and safety. Primary COCs in soil that could present potential risks to future Site receptors included PCBs and dioxins/furans. Ground water COCs did not present a risk to receptors. The FRA shows that removal of principal threat waste (PCBs > 500 mg/kg) and co-located dioxins/furans and other COCs, combined with the proposed redevelopment of the site, supports the use of a risk-based cleanup approach. The FRA indicates that the selected remedy is protective and does not present unreasonable risk to human health and safety based on the future use scenario (Appendix A).

5.4 REMEDIAL ACTION COST ESTIMATE

The total cost for implementation of the selected remedy is approximately $17.9 million. This estimate includes approximately $3.7 million expended for work completed to date, and $14.2 million to conduct the work described in this report. The money spent to date excludes remedial investigation costs and represents site response actions for building demolition, asbestos removal and disposal, management of illegally dumped debris, hazardous waste characterization and disposal, ongoing site security, settlement of EPA's past response costs, and payment for EPA's oversight costs.

The estimate for the remainder of the selected remedy is for work described in this report including excavation and disposal of the principal threat wastes, consolidation of on-site soils to create utility corridors, backfill and/or two feet of soil cover where required, and completion of ground water modeling and monitoring.

6.0 REFERENCES

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Dan Raviv Associates, Inc., April 18, 1986, updated July 1986. *Soils and Ground Water Characterization Bayonne Barrel and Drum Company, Newark, New Jersey,* Job No. 84C182.

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Roy F. Weston Inc. May 1999 (b). *Revised Reduced Data Report,* Data from USEPA/Weston ground water sampling event in November and December 1998.

USEPA, August 14, 1996. Letter to *de maximis inc.* regarding data summary for collection and analysis of drum and soil samples at the Bayonne Barrel and Drum Site.

USGS, 1998. *Bedrock Geologic Map of Central and Southern New Jersey.* Miscellaneous Investigations Series Map I-2540-B, 1998.

Wehran Engineering Corporation, October 1988. *Summary Report of the Test Pit and Monitoring Well Investigation at the Newark Drive-In Site.*

TABLES

TABLE 3-1

CHEMICALS OF CONCERN IN SOIL/SEDIMENT IN EXCESS OF NJDEP RESTRICTED USE SOIL CLEANUP CRITERIA BAYONNE BARREL & DRUM SITE - NEWARK, NJ

SOIL

PCBs

Dioxins

Pesticides
Aldrin
4,4'-DDD
4,4'-DDE
Dieldrin
Endosulfan sulfate
Heptachlor

Volatile Organic Compounds
Benzene
Ethylbenzene
Tetrachloroethene
Toluene
Trichloroethene
Xylene (Total)

Semi-Volatile Organic Compounds
Benzo(a)anthracene
bis(2-ethylhexyl)phthalate
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene

Metals
Antimony
Arsenic
Beryllium
Cadmium
Copper
Lead
Zinc

SEDIMENT

PCBs

Semi-Volatile Organic Compounds
Benzo(a)anthracene
Benzo(a)pyrene

Metals
Lead
Copper

TABLE 3-2

CHEMICALS OF CONCERN IN GROUNDWATER IN EXCESS OF CLASS IIA GROUNDWATER QUALITY STANDARDS BAYONNE BARREL & DRUM SITE - NEWARK, NJ

Volatile Organic Compounds

Benzene
Methylene Chloride
Tetrachloroethene
Trichloroethene
1,1,2-Trichloroethane

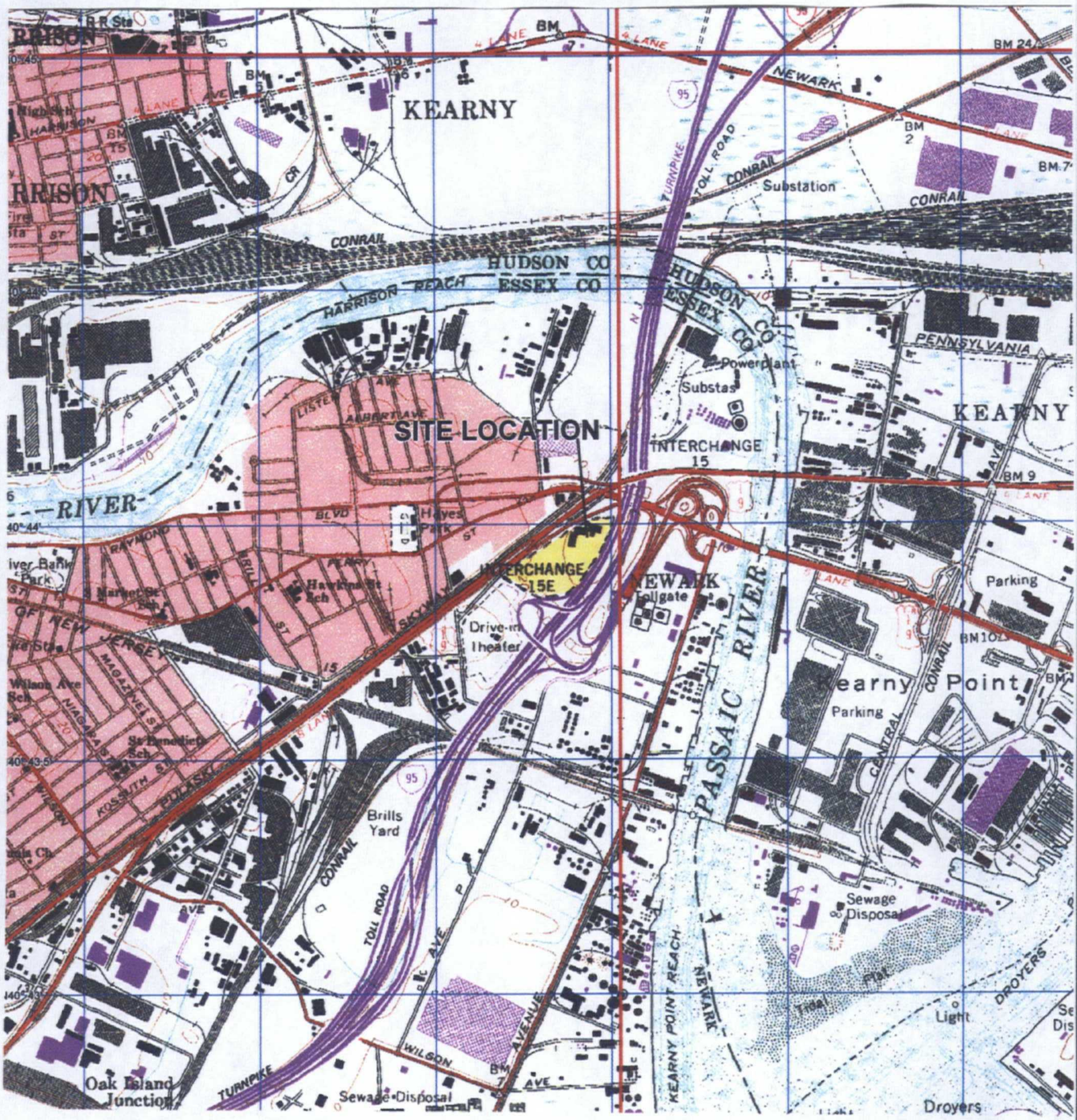
Semi-Volatile Organic Compounds

2-4-Dimethylphenol
Naphthalene
2-Methylnaphthalene
Benzo(a)anthracene
Chrysene

Metals

Aluminum
Antimony
Arsenic
Iron
Lead
Manganese
Sodium

FIGURES



QUEST

ENVIRONMENTAL & ENGINEERING SERVICES, INC.

SITE LOCATION MAP

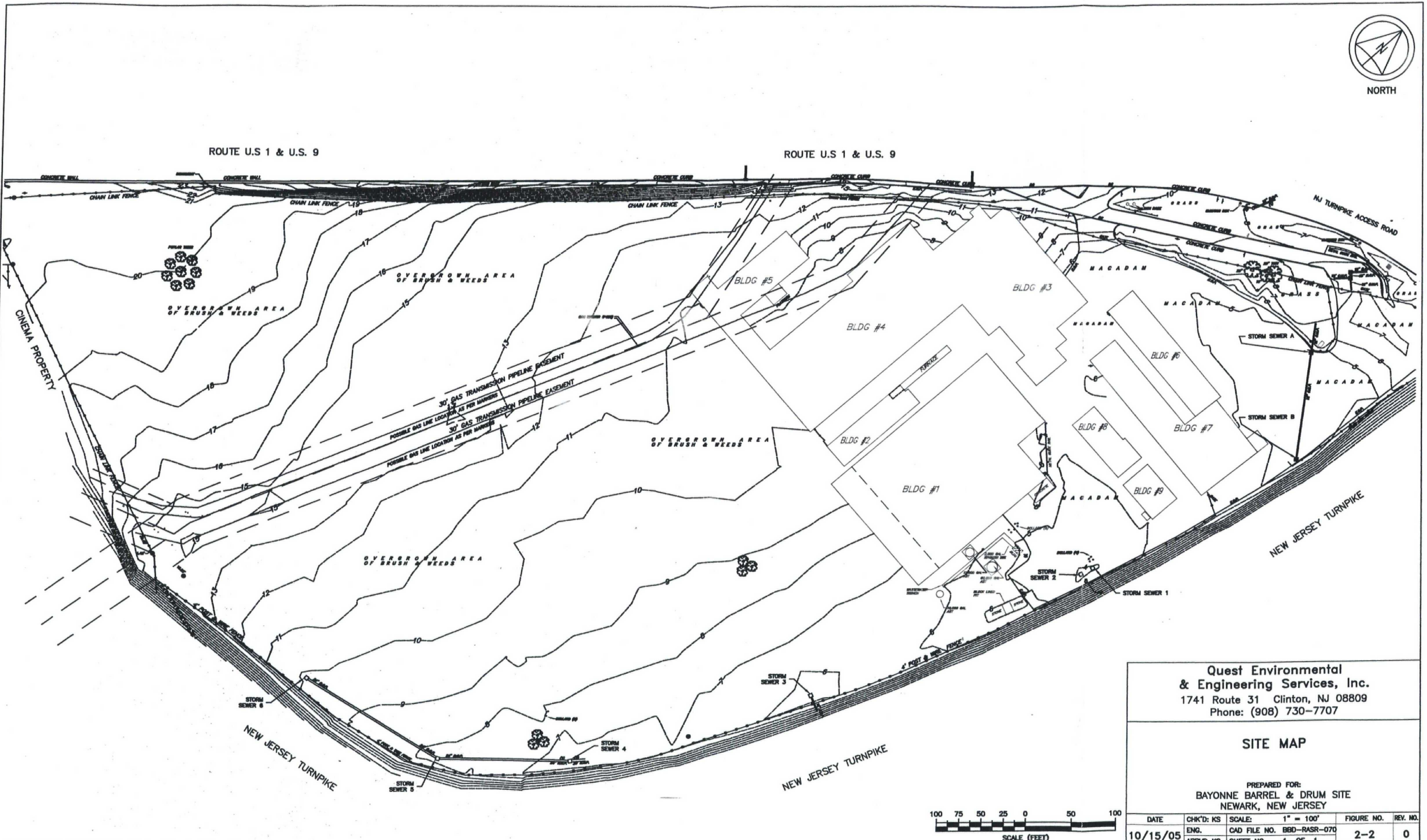
Source: 7.5 Minute Series, Topographic Maps
Elizabeth & Jersey City, NJ-NY Quads

QUADRANGLE LOCATION

PREPARED FOR:

BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY

DATE	SCALE	CHK'D	FIGURE NO.	REV. NO.
10/20/04	1 in = 2000 ft	KS	**2-1**	1



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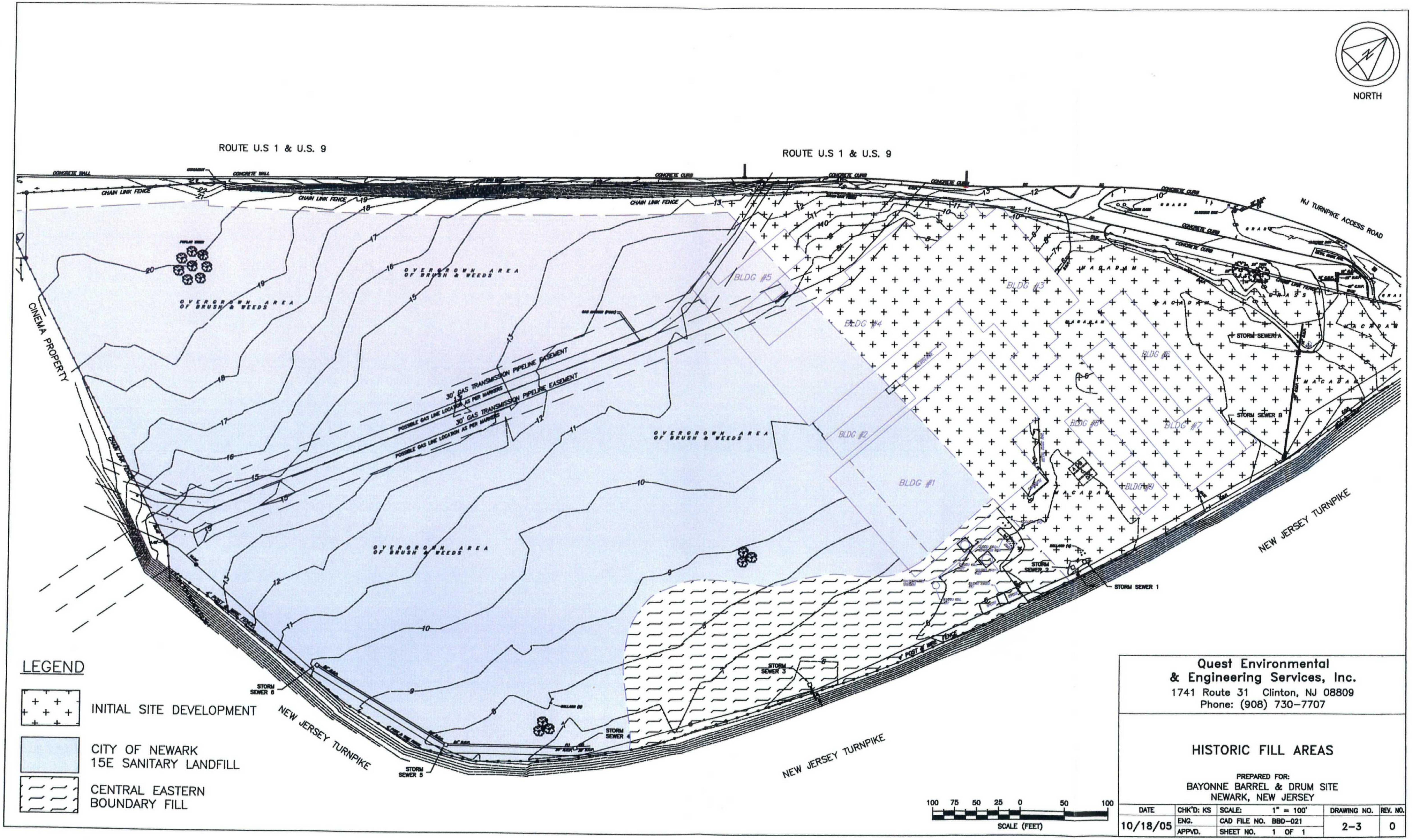
SITE MAP

PREPARED FOR:
BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY

DATE	CHK'D: KS	SCALE: 1" = 100'	FIGURE NO.	REV. NO.
10/15/05	ENG.	CAD FILE NO. BBD-RASR-070	2-2	0
	APPVD. KS	SHEET NO. 1 OF 1		



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HISTORIC FILL AREAS

PREPARED FOR:
BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY

DATE	CHK'D: KS	SCALE: 1" = 100'	DRAWING NO.	REV. NO.
10/18/05	ENG.	CAD FILE NO. BBD-021	2-3	0
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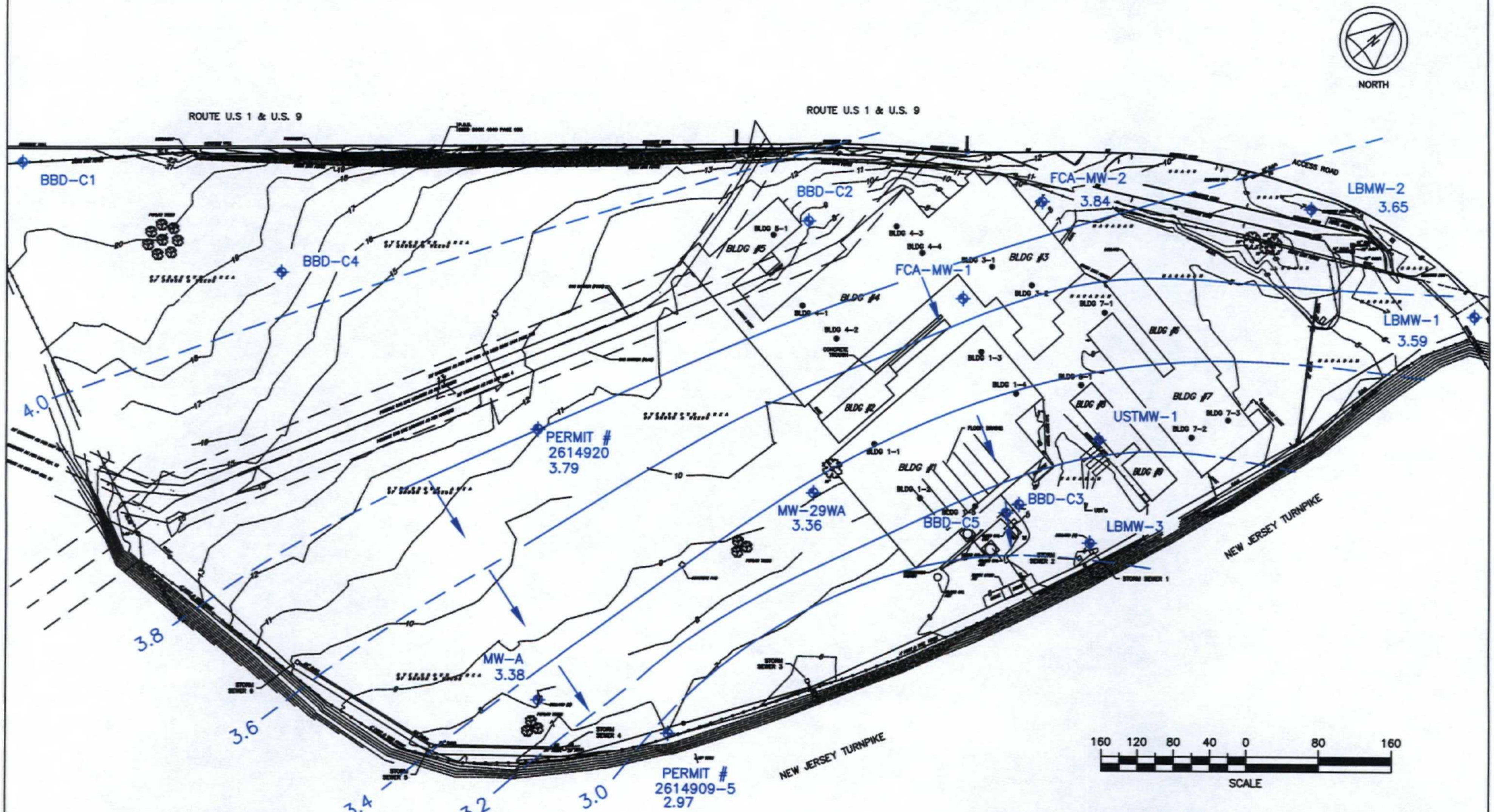

LEGEND

MW-A — MONITORING WELL

2.97 — ELEVATION IN FEET ABOVE MSL

—3— — LINE OF EQUAL ELEVATION

GROUND WATER FLOW DIRECTION

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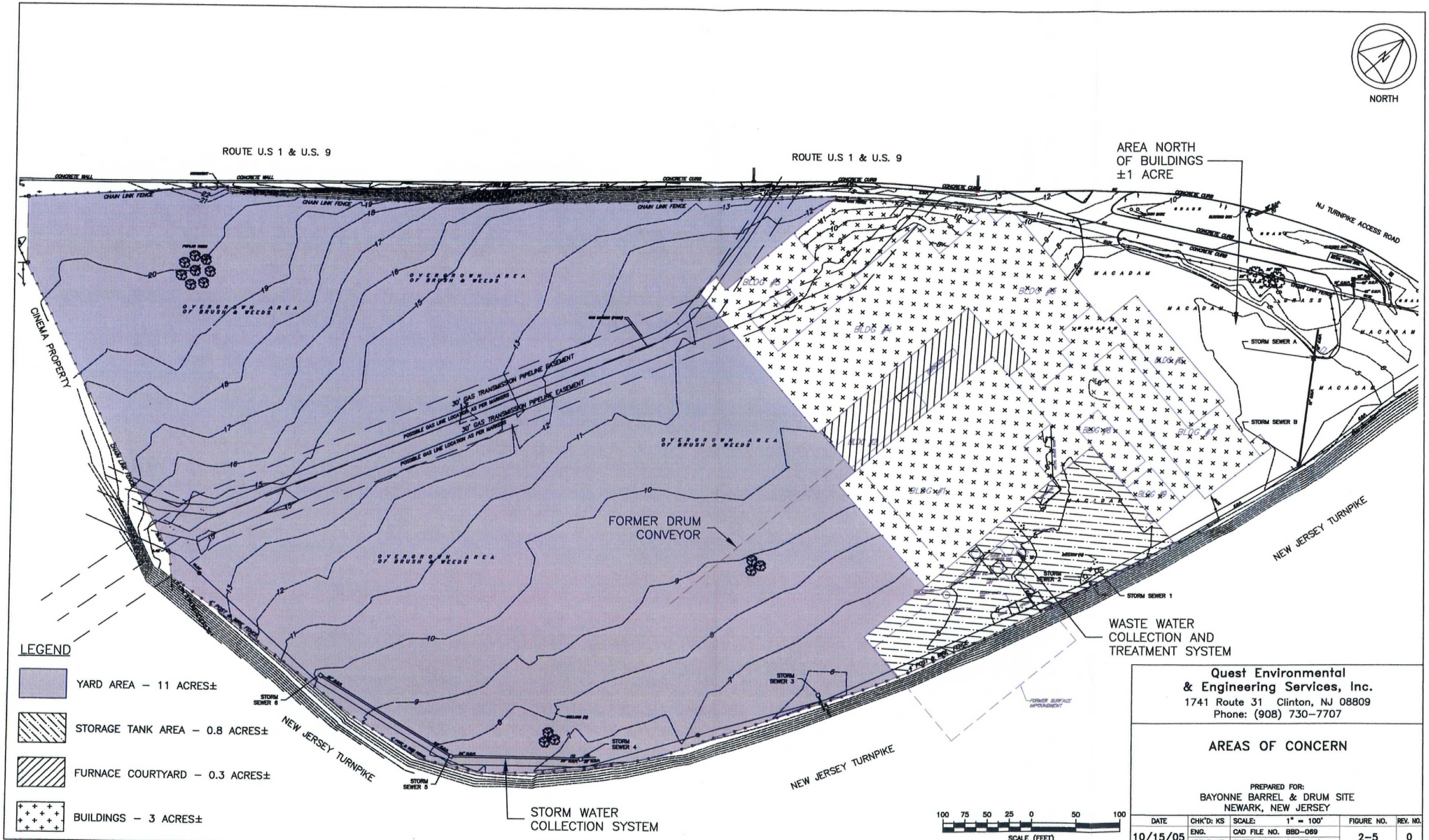
GROUND WATER ELEVATION CONTOUR MAP: FILL-CLAY-SAND LAYERS: SEPT. 14, 2004

PREPARED FOR:
BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY

DATE	CHK'D: KS	SCALE: 1" = 160'	FIGURE NO.	REV. NO.
10/20/05	ENG.	CAD FILE NO.	2-4	
	APPVD. KS	SHEET NO.		



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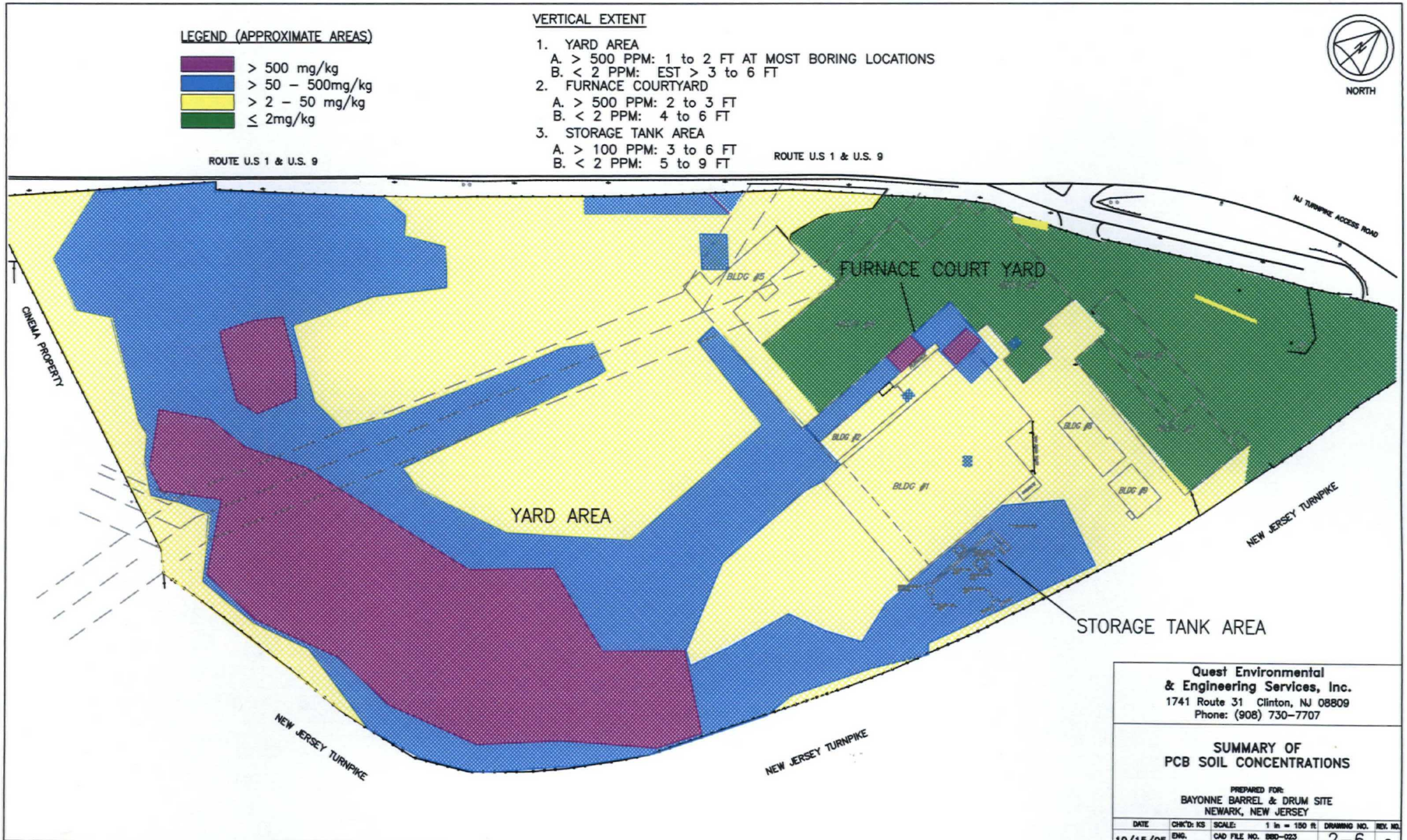
AREAS OF CONCERN

PREPARED FOR:
BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY

DATE	CHK'D: KS	SCALE: 1" = 100'	FIGURE NO.	REV. NO.
10/15/05	ENG.	CAD FILE NO. BBD-069	2-5	0
	APPVD. KS	SHEET NO. 1 OF 1		


LEGEND (APPROXIMATE AREAS)
> 500 mg/kg
> 50 – 500mg/kg
> 2 – 50 mg/kg
≤ 2mg/kg
VERTICAL EXTENT
1. YARD AREA
A. > 500 PPM: 1 to 2 FT AT MOST BORING LOCATIONS
B. < 2 PPM: EST > 3 to 6 FT
2. FURNACE COURTYARD
A. > 500 PPM: 2 to 3 FT
B. < 2 PPM: 4 to 6 FT
3. STORAGE TANK AREA
A. > 100 PPM: 3 to 6 FT
B. < 2 PPM: 5 to 9 FT
NORTH
ROUTE U.S 1 & U.S. 9
ROUTE U.S 1 & U.S. 9
NJ TURNPIKE ACCESS ROAD
CINEMA PROPERTY
FURNACE COURT YARD
BLDG #5
BLDG #2
BLDG #1
BLDG #8
BLDG #9
YARD AREA
STORAGE TANK AREA
NEW JERSEY TURNPIKE
NEW JERSEY TURNPIKE
NEW JERSEY TURNPIKE
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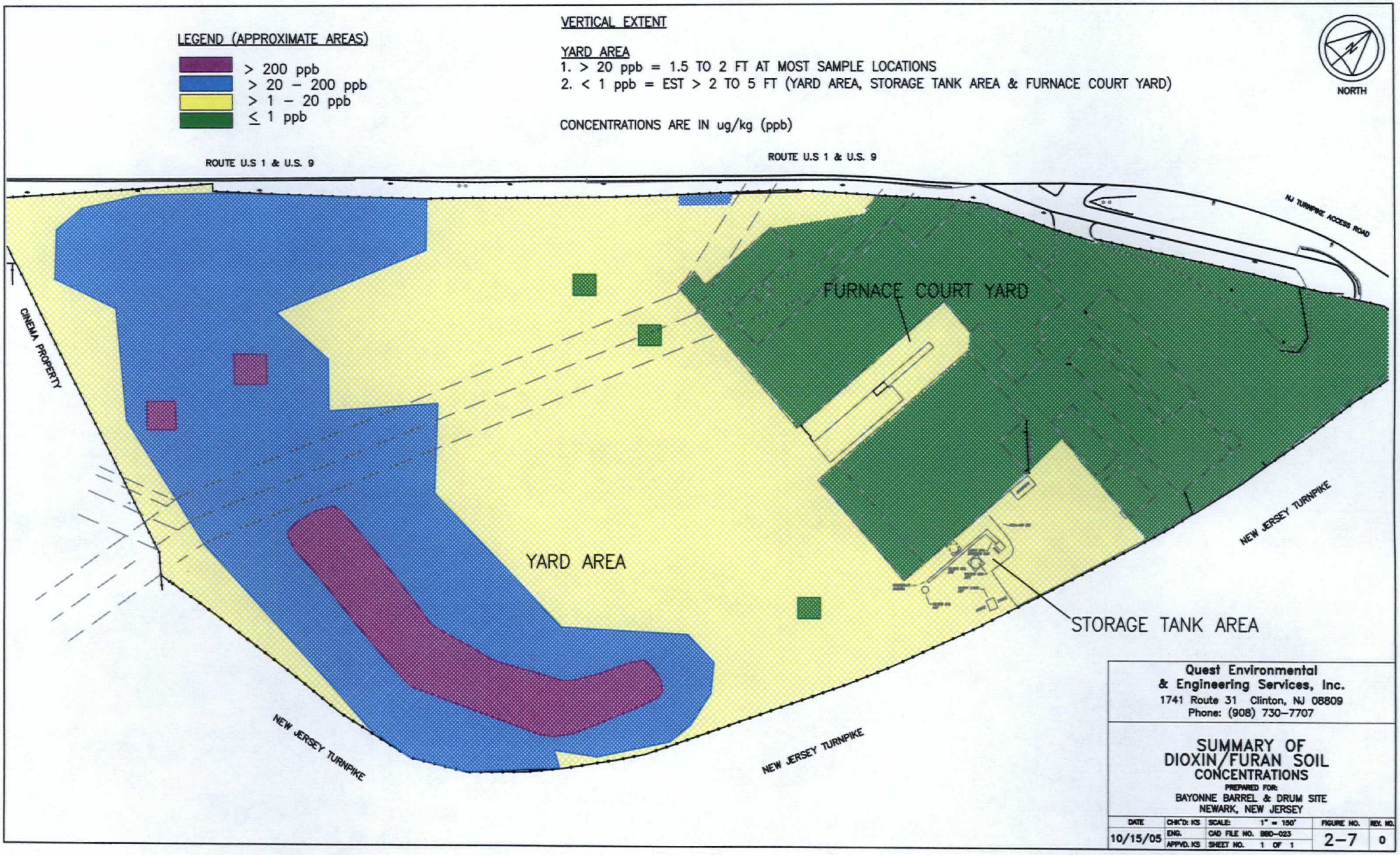
SUMMARY OF
PCB SOIL CONCENTRATIONS
PREPARED FOR:
BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY
DATE 10/15/05
CHK'D: KS
ENG.
APPVD.
SCALE: 1 in = 150 ft
CAD FILE NO. BBD-023
SHEET NO. 1 OF 1
DRAWING NO. 2-6
REV. NO. 0


LEGEND (APPROXIMATE AREAS)
> 200 ppb
> 20 - 200 ppb
> 1 - 20 ppb
≤ 1 ppb
VERTICAL EXTENT
YARD AREA
1. > 20 ppb = 1.5 TO 2 FT AT MOST SAMPLE LOCATIONS
2. < 1 ppb = EST > 2 TO 5 FT (YARD AREA, STORAGE TANK AREA & FURNACE COURT YARD)
CONCENTRATIONS ARE IN ug/kg (ppb)
NORTH
ROUTE U.S 1 & U.S. 9
ROUTE U.S 1 & U.S. 9
NJ TURNPIKE ACCESS ROAD
CINEMA PROPERTY
FURNACE COURT YARD
YARD AREA
STORAGE TANK AREA
NEW JERSEY TURNPIKE
NEW JERSEY TURNPIKE
NEW JERSEY TURNPIKE
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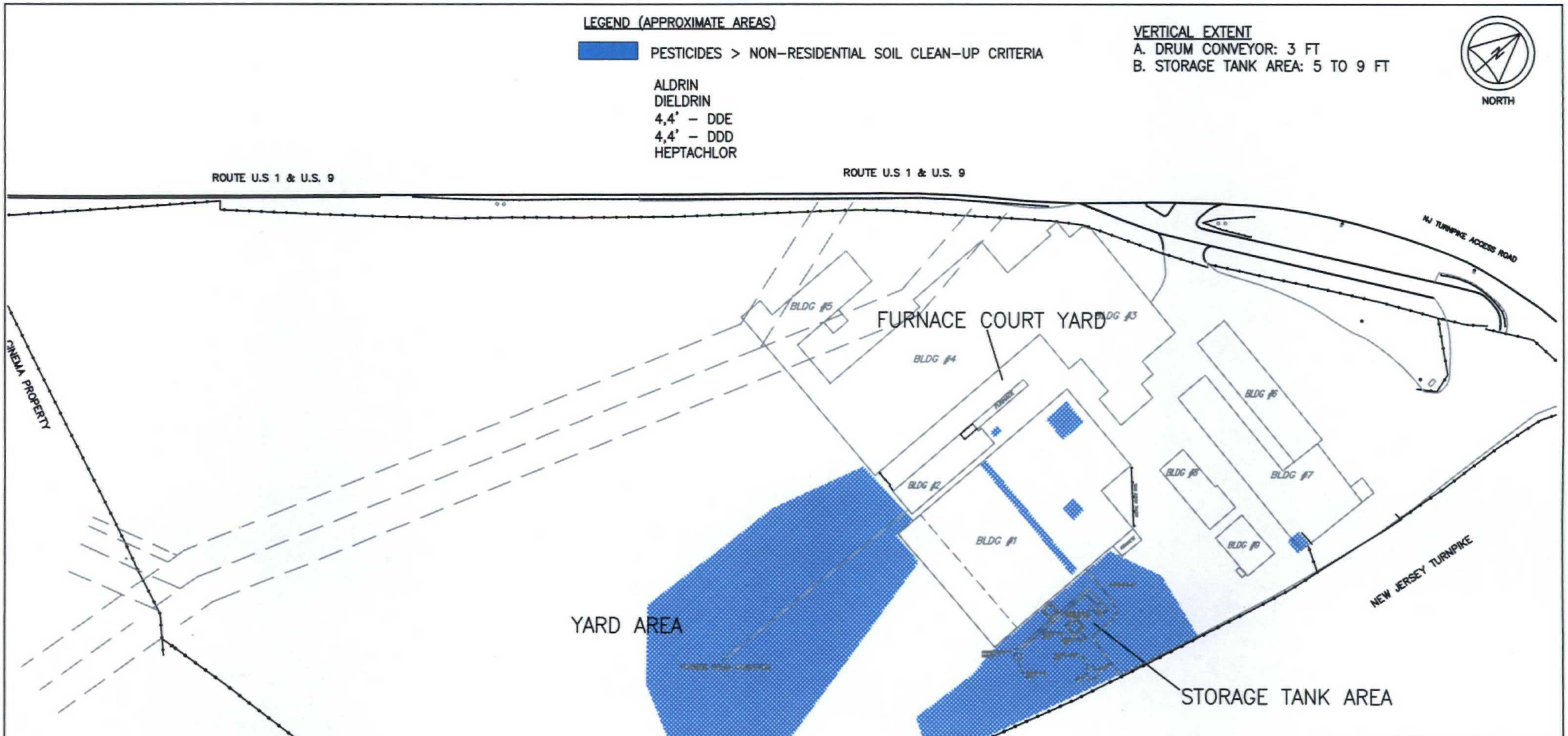
SUMMARY OF DIOXIN/FURAN SOIL CONCENTRATIONS
PREPARED FOR:
BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY
DATE 10/15/05
CHK'D: KS
ENG.
APPVD. KS
SCALE: 1" = 150'
CAD FILE NO. BBD-023
SHEET NO. 1 OF 1
FIGURE NO. 2-7
REV. NO. 0



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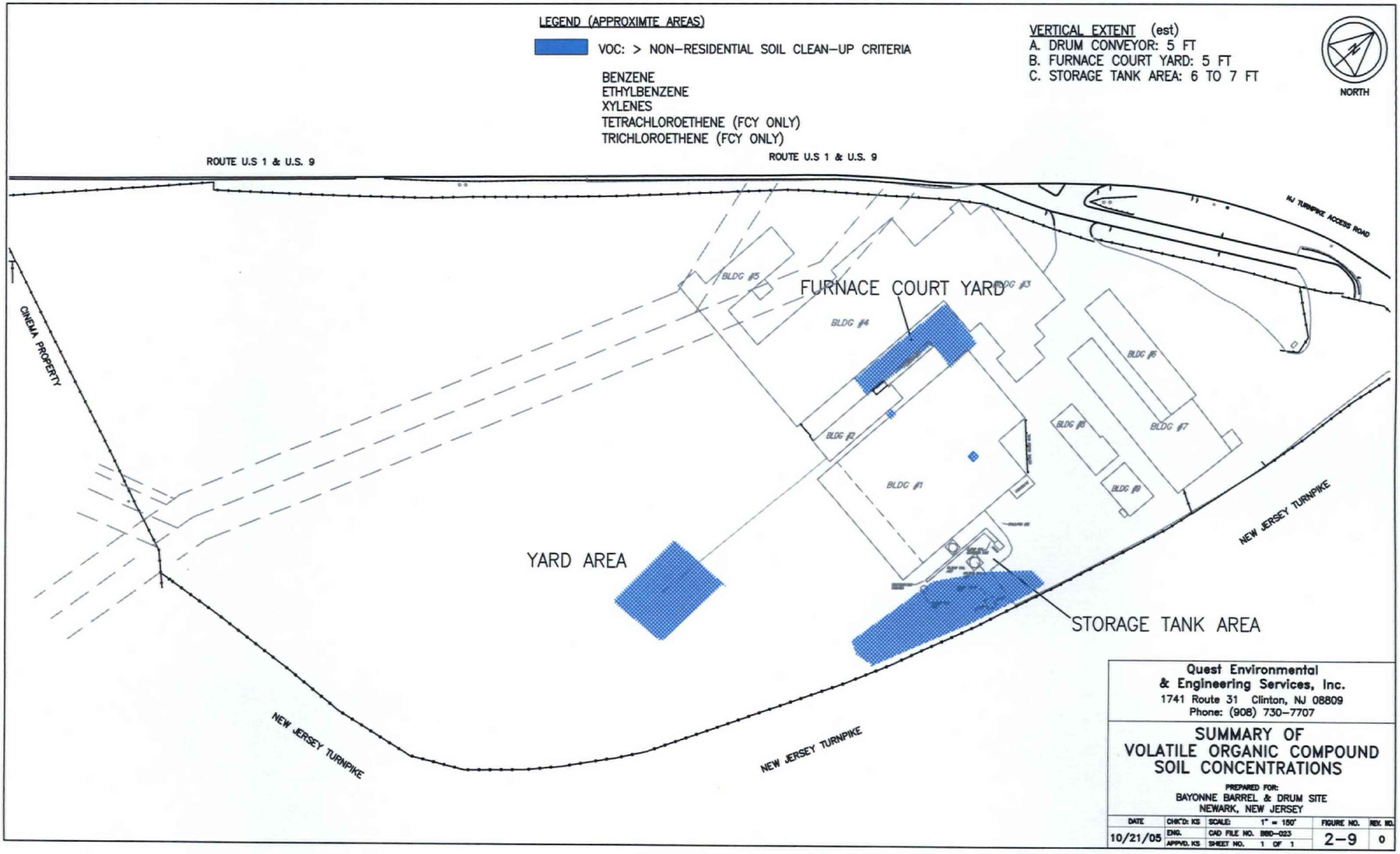
SUMMARY OF PESTICIDE SOIL CONCENTRATIONS

PREPARED FOR:
BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY

DATE	CHK'D: KS	SCALE: 1" = 150'	FIGURE NO.	REV. NO.
10/15/05	ENG.	CAD FILE NO. BBD-023	2-8	0
	APPVD. KS	SHEET NO. 1 OF 1		


LEGEND (APPROXIMTE AREAS)
VOC: > NON-RESIDENTIAL SOIL CLEAN-UP CRITERIA
BENZENE
ETHYLBENZENE
XYLENES
TETRACHLOROETHENE (FCY ONLY)
TRICHLOROETHENE (FCY ONLY)
VERTICAL EXTENT (est)
A. DRUM CONVEYOR: 5 FT
B. FURNACE COURT YARD: 5 FT
C. STORAGE TANK AREA: 6 TO 7 FT
NORTH
ROUTE U.S 1 & U.S. 9
ROUTE U.S 1 & U.S. 9
NJ TURNPIKE ACCESS ROAD
CINEMA PROPERTY
BLDG #5
FURNACE COURT YARD
BLDG #3
BLDG #4
BLDG #6
BLDG #2
BLDG #8
BLDG #7
BLDG #1
BLDG #9
NEW JERSEY TURNPIKE
YARD AREA
STORAGE TANK AREA
NEW JERSEY TURNPIKE
NEW JERSEY TURNPIKE
Quest Environmental
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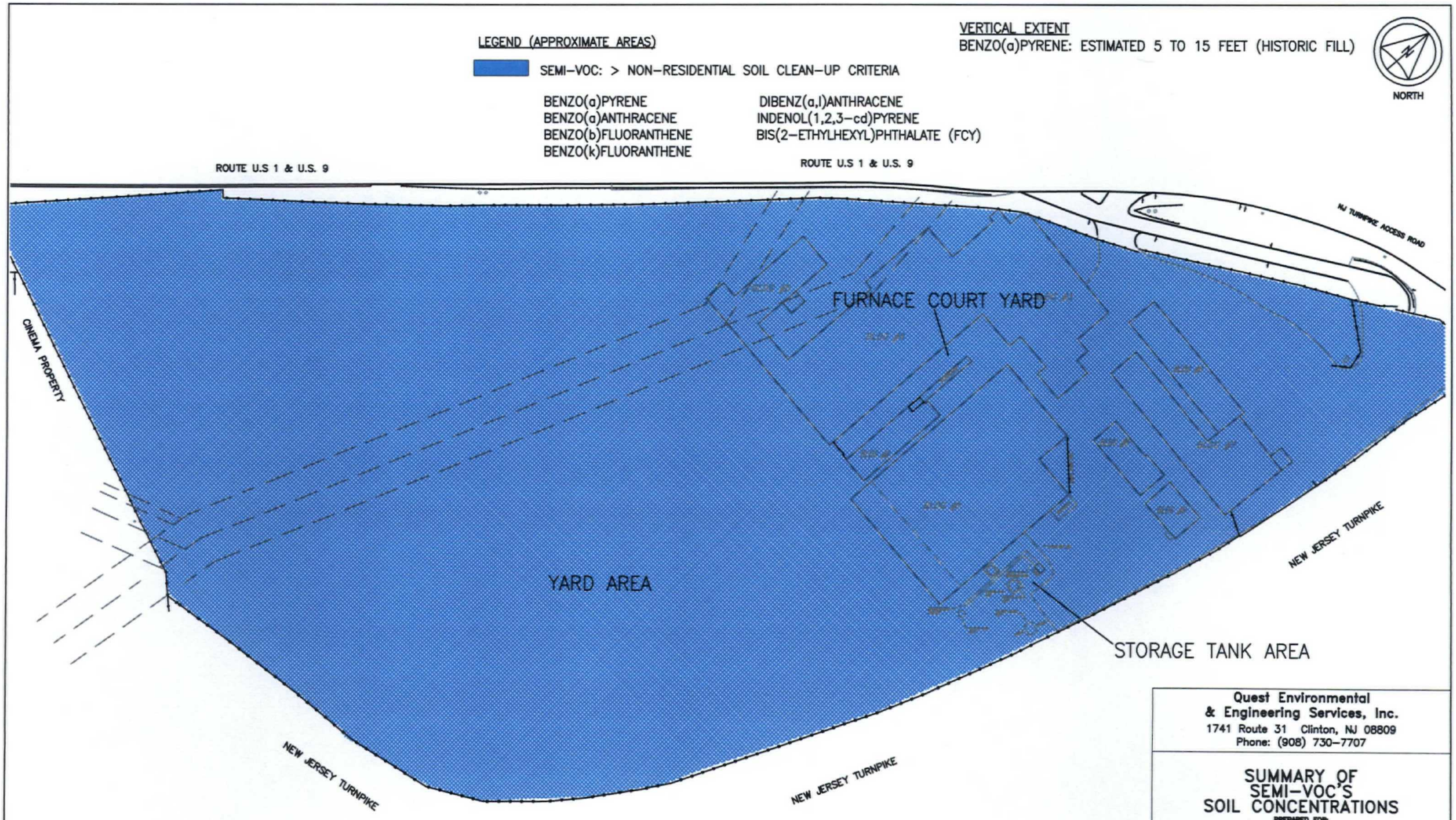
SUMMARY OF
VOLATILE ORGANIC COMPOUND
SOIL CONCENTRATIONS
PREPARED FOR:
BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY
DATE 10/21/05
CHK'D: KS
ENG.
APPVD. KS
SCALE: 1" = 150'
CAD FILE NO. BBD-023
SHEET NO. 1 OF 1
FIGURE NO. 2-9
REV. NO. 0



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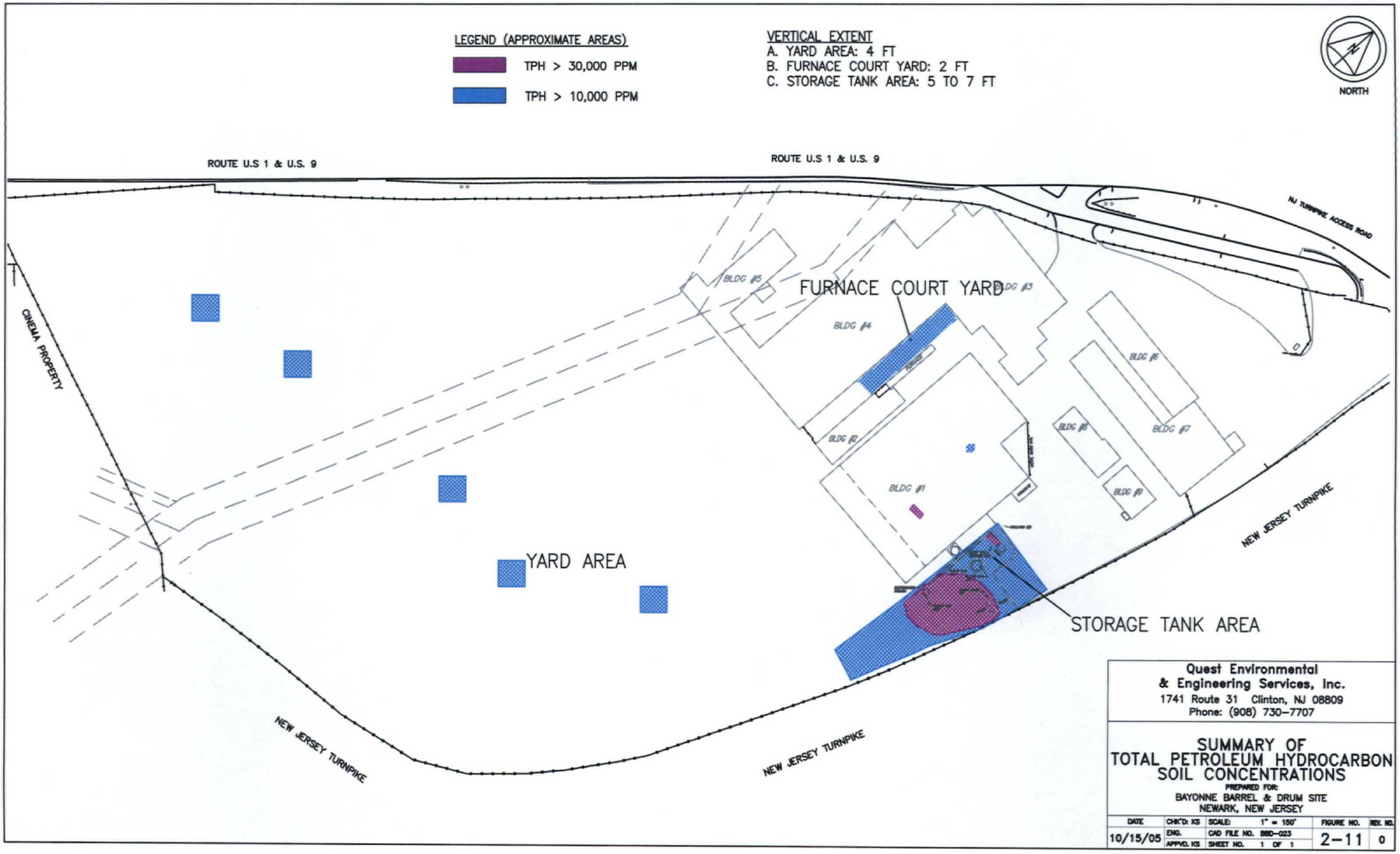
SUMMARY OF SEMI-VOC'S SOIL CONCENTRATIONS

PREPARED FOR:
BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY

DATE	CHK'D: KS	SCALE: 1" = 150'	DRAWING NO.	REV. NO.
10/11/05	ENG.	CAD FILE NO. BBD-023	2-10	0
	APPVD.	SHEET NO. 1 OF 1		



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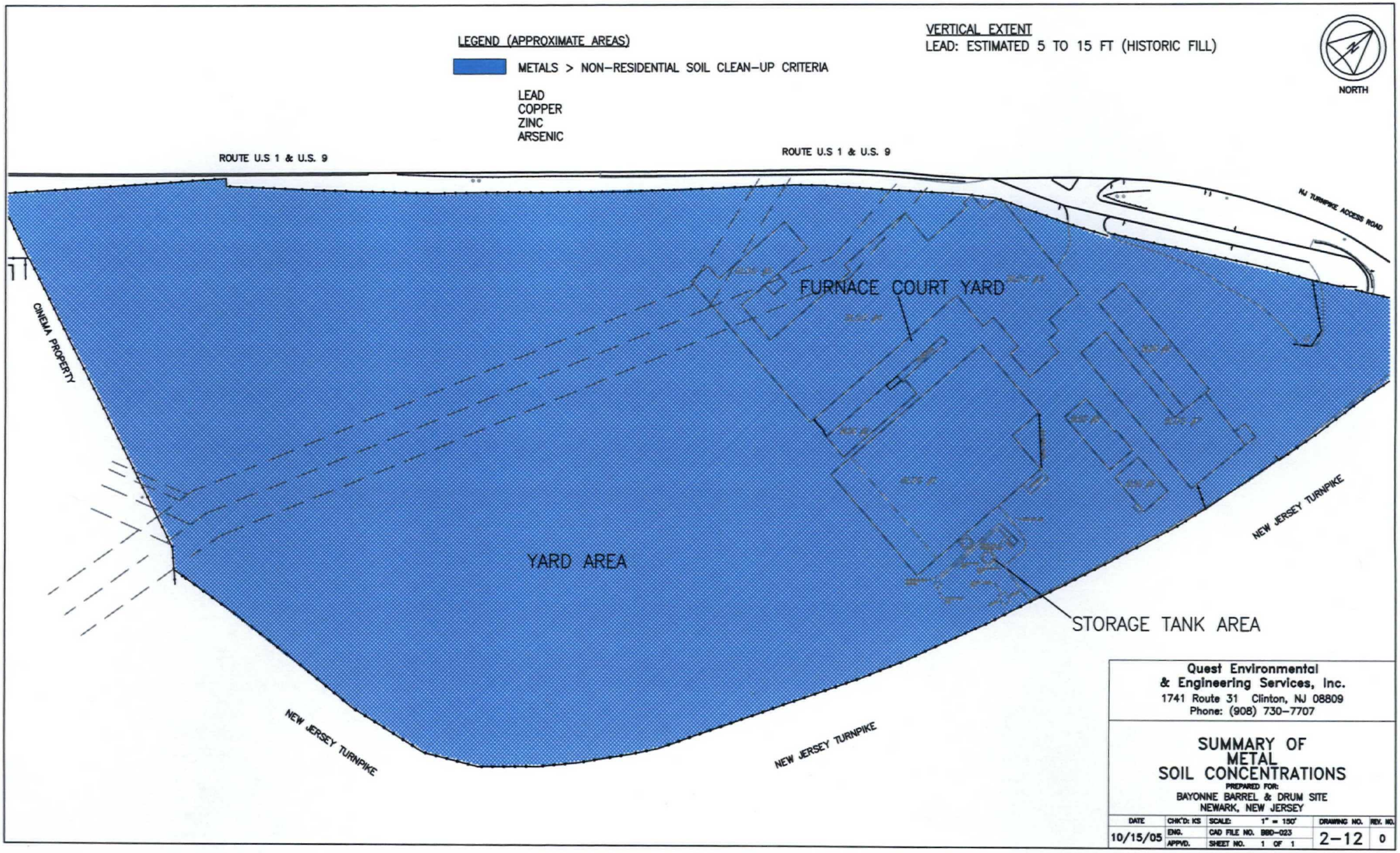
SUMMARY OF TOTAL PETROLEUM HYDROCARBON SOIL CONCENTRATIONS

PREPARED FOR:
BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY

DATE	CHK'D: KS	SCALE: 1" = 150'	FIGURE NO.	REV. NO.
10/15/05	ENG.	CAD FILE NO. BBD-023	2-11	0
	APPVD. KS	SHEET NO. 1 OF 1		


LEGEND (APPROXIMATE AREAS)
METALS > NON-RESIDENTIAL SOIL CLEAN-UP CRITERIA
LEAD
COPPER
ZINC
ARSENIC
VERTICAL EXTENT
LEAD: ESTIMATED 5 TO 15 FT (HISTORIC FILL)
NORTH
ROUTE U.S 1 & U.S. 9
ROUTE U.S 1 & U.S. 9
NJ TURNPIKE ACCESS ROAD
CINEMA PROPERTY
FURNACE COURT YARD
YARD AREA
STORAGE TANK AREA
NEW JERSEY TURNPIKE
NEW JERSEY TURNPIKE
NEW JERSEY TURNPIKE
Quest Environmental
& Engineering Services, Inc.
1741 Route 31 Clinton, NJ 08809
Phone: (908) 730-7707
SUMMARY OF METAL SOIL CONCENTRATIONS
PREPARED FOR:
BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY
DATE 10/15/05
CHK'D: KS
ENG.
APPVD.
SCALE: 1" = 150'
CAD FILE NO. BBD-023
SHEET NO. 1 OF 1
DRAWING NO. 2-12
REV. NO. 0

BBD-C1	
VOCs	
Methylene Chloride	ND
Trichloroethene	ND
1,1,2-Trichloroethane	ND
Benzene	ND
Tetrachloroethene	ND
SVOCs	
Naphthalene	ND
2-Methylnaphthalene	ND
Pesticides	ND
PCBs	ND
Metals	
Antimony	5.9
Arsenic	14.8
Lead	6.4

BBD-C4	
VOCs	
Methylene Chloride	ND
Trichloroethene	ND
1,1,2-Trichloroethane	ND
Benzene	ND
Tetrachloroethene	ND
SVOCs	
Naphthalene	ND
2-Methylnaphthalene	ND
Pesticides	ND
PCBs	ND
Metals	
Antimony	6
Arsenic	10.9
Lead	ND

2614920	
VOCs	
Methylene Chloride	ND
Trichloroethene	ND
1,1,2-Trichloroethane	ND
Benzene	ND
Tetrachloroethene	ND
SVOCs	
Naphthalene	ND
2-Methylnaphthalene	ND
Pesticides	ND
PCBs	ND
Metals	
Antimony	ND
Arsenic	ND
Lead	ND

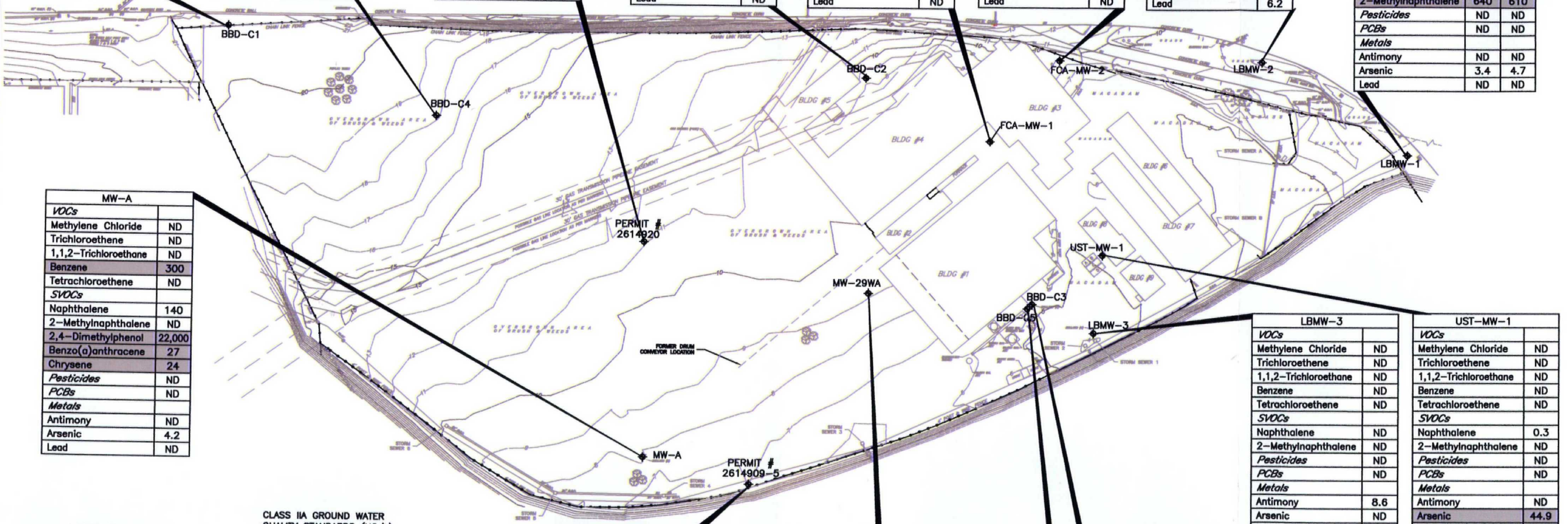
BBD-C2	
VOCs	
Methylene Chloride	ND
Trichloroethene	ND
1,1,2-Trichloroethane	ND
Benzene	ND
Tetrachloroethene	ND
SVOCs	
Naphthalene	1.1
2-Methylnaphthalene	ND
Pesticides	ND
PCBs	ND
Metals	
Antimony	62.2
Arsenic	ND
Lead	ND

FCA-MW-1	
VOCs	
Methylene Chloride	6.3
Trichloroethene	7.5
1,1,2-Trichloroethane	6.5
Benzene	18
Tetrachloroethene	6.6
SVOCs	
Naphthalene	3.9
2-Methylnaphthalene	0.6
2,4-Dimethylphenol	8.9
Pesticides	ND
PCBs	ND
Metals	
Antimony	ND
Arsenic	7.7
Lead	ND

FCA-MW-2	
VOCs	
Methylene Chloride	ND
Trichloroethene	ND
1,1,2-Trichloroethane	ND
Benzene	ND
Tetrachloroethene	ND
SVOCs	
Naphthalene	ND
2-Methylnaphthalene	ND
Pesticides	ND
PCBs	ND
Metals	
Antimony	ND
Arsenic	ND
Lead	ND

LBMW-2	
VOCs	
Methylene Chloride	ND
Trichloroethene	ND
1,1,2-Trichloroethane	ND
Benzene	ND
Tetrachloroethene	ND
SVOCs	
Naphthalene	ND
2-Methylnaphthalene	ND
Pesticides	ND
PCBs	ND
Metals	
Antimony	ND
Arsenic	22.6
Lead	6.2

	LBMW-1	MW-FD
VOCs		
Methylene Chloride	ND	ND
Trichloroethene	ND	ND
1,1,2-Trichloroethane	ND	ND
Benzene	3.8	4.7
Tetrachloroethene	ND	ND
SVOCs		
Naphthalene	600	610
2-Methylnaphthalene	640	610
Pesticides	ND	ND
PCBs	ND	ND
Metals		
Antimony	ND	ND
Arsenic	3.4	4.7
Lead	ND	ND



MW-A	
VOCs	
Methylene Chloride	ND
Trichloroethene	ND
1,1,2-Trichloroethane	ND
Benzene	300
Tetrachloroethene	ND
SVOCs	
Naphthalene	140
2-Methylnaphthalene	ND
2,4-Dimethylphenol	22,000
Benzo(a)anthracene	27
Chrysene	24
Pesticides	ND
PCBs	ND
Metals	
Antimony	ND
Arsenic	4.2
Lead	ND

LBMW-3	
VOCs	
Methylene Chloride	ND
Trichloroethene	ND
1,1,2-Trichloroethane	ND
Benzene	ND
Tetrachloroethene	ND
SVOCs	
Naphthalene	ND
2-Methylnaphthalene	ND
Pesticides	ND
PCBs	ND
Metals	
Antimony	8.6
Arsenic	ND
Lead	7.7

UST-MW-1	
VOCs	
Methylene Chloride	ND
Trichloroethene	ND
1,1,2-Trichloroethane	ND
Benzene	ND
Tetrachloroethene	ND
SVOCs	
Naphthalene	0.3
2-Methylnaphthalene	ND
Pesticides	ND
PCBs	ND
Metals	
Antimony	ND
Arsenic	44.9
Lead	ND

LEGEND

— — — PROPERTY LINE

BBD-C2 MONITORING WELL

EXISTING FENCE LINE

RESULTS ARE IN UG/L

SHADED CONCENTRATIONS EXCEEDS GROUND WATER QUALITY STANDARDS

CLASS IIA GROUND WATER QUALITY STANDARDS (UG/L)

VOCs	
Methylene Chloride	3[A]
Trichloroethene	1
1,1,2-Trichloroethene	3
Tetrachloroethene	1
Benzene	1
SVOCs	
Naphthalene	300[A]
2-methylnaphthalene	100[A]
2,4-Dimethylphenol	100
Benzo(a)anthracene	0.2[A]
Chrysene	5[A]
METALS	
Antimony	20
Arsenic	8
Lead	10

A = Interim specific criteria

2614909-5	
VOCs	
Methylene Chloride	ND
Trichloroethene	ND
1,1,2-Trichloroethane	ND
Benzene	390
Tetrachloroethene	ND
SVOCs	
Naphthalene	140
2-Methylnaphthalene	71
2,4-Dimethylphenol	31
Pesticides	ND
PCBs	ND
Metals	
Antimony	ND
Arsenic	ND
Lead	ND

MW-29WA	
VOCs	
Methylene Chloride	ND
Trichloroethene	ND
1,1,2-Trichloroethane	ND
Benzene	ND
Tetrachloroethene	ND
SVOCs	
Naphthalene	0.3
2-Methylnaphthalene	ND
Pesticides	ND
PCBs	ND
Metals	
Antimony	ND
Arsenic	4.6
Lead	4

BBD-C5	
VOCs	
Methylene Chloride	ND
Trichloroethene	ND
1,1,2-Trichloroethane	ND
Benzene	7
Tetrachloroethene	ND
SVOCs	
Naphthalene	0.7
2-Methylnaphthalene	1.6
Pesticides	ND
PCBs	ND
Metals	
Antimony	ND
Arsenic	ND
Lead	41.4

BBD-C3	
VOCs	
Methylene Chloride	ND
Trichloroethene	ND
1,1,2-Trichloroethane	ND
Benzene	13
Tetrachloroethene	ND
SVOCs	
Naphthalene	1.7
2-Methylnaphthalene	ND
Pesticides	ND
PCBs	ND
Metals	
Antimony	ND
Arsenic	14.7
Lead	ND

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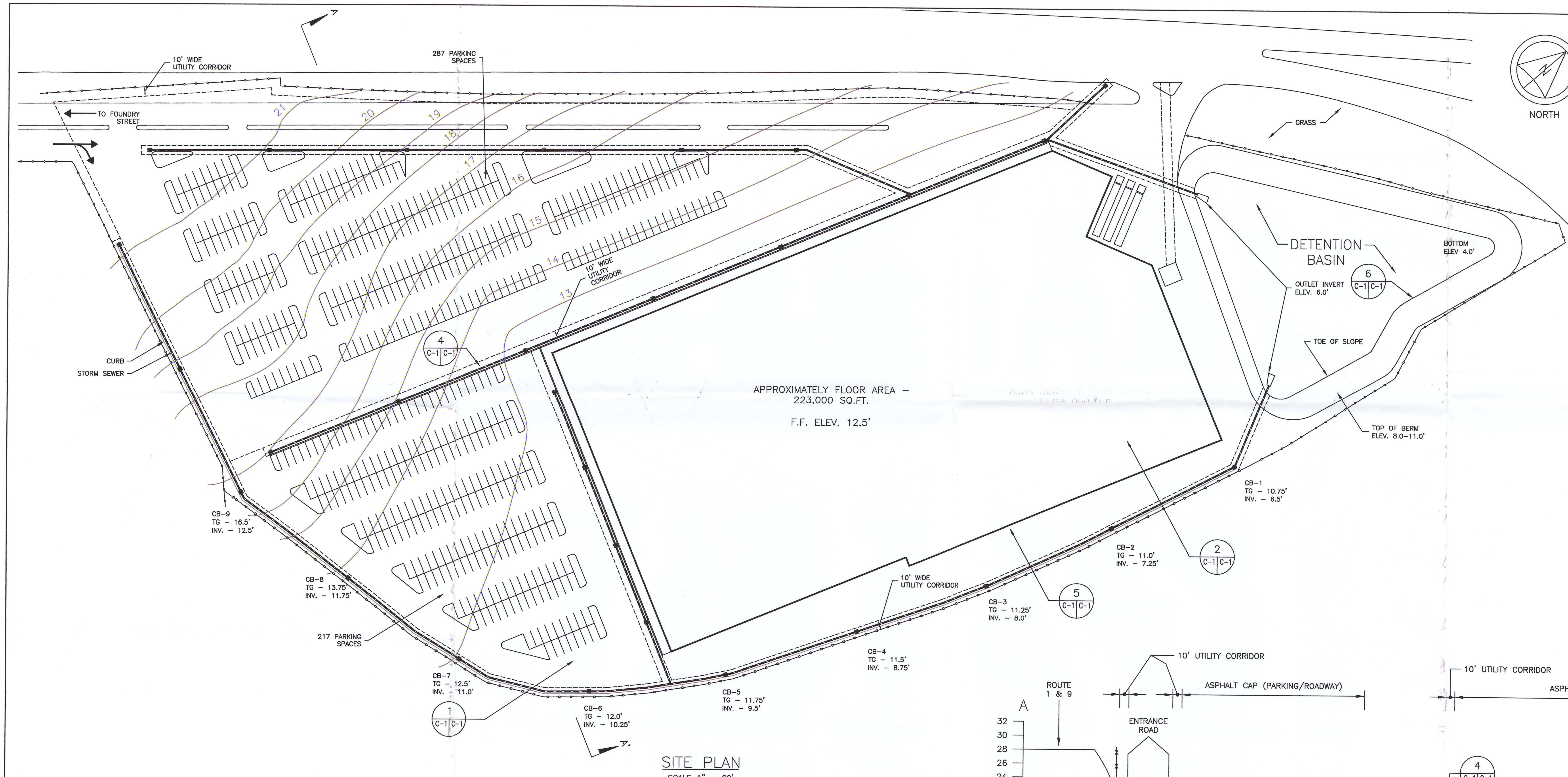
JULY 2004 GROUND WATER SAMPLING RESULTS

BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY

PROJECT NO.	CHK'D: KS	SCALE: 1" = 150'	FIGURE NO.	REV. NO.
	ENG.	CAD FILE NO. BBD-058	2-13	0
	APPVD.	SHEET NO. 1 OF 1		



SITE PLAN
SCALE 1" = 60'

LEGEND

- BUILDING OUTLINE
- STORM SEWER LINE
- CATCH BASIN
- NEW GRADE LINE
- COMMON BORROW
- MANAGED SOIL ZONE (CONSOLIDATED)
- MANAGED SOIL ZONE (IN PLACE)
- ASPHALT

Notes on Newark Building Codes

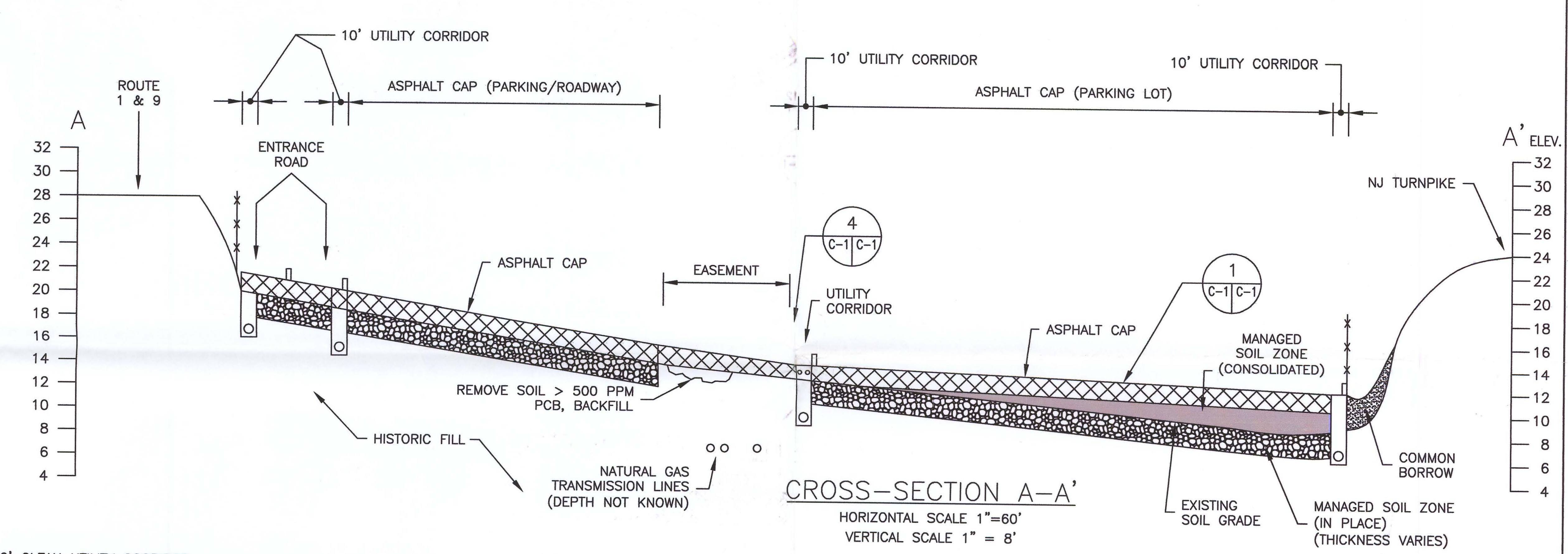
1. Zone Designation: Third Industrial Area – I3
2. District Regulations: 40:3-53 through 3-60
   a. Building Height Regulations: 12 stories allowed for 4 acres of building.
   b. Area Regulations: Set back of 10 feet from street line (for sites greater than 4 acres).
   c. Fencing Regulations: Fencing may be 12 feet high (open style).
3. Off-Street Parking/Loading Regulations
   a. 3 loading berths required for first 40,000 sq. ft. plus 1 berth for each additional 20,000 sq. ft.

Square Footage	Berths
0 – 40,000	3
100,000	6
140,000	8
180,000	10
220,000	12

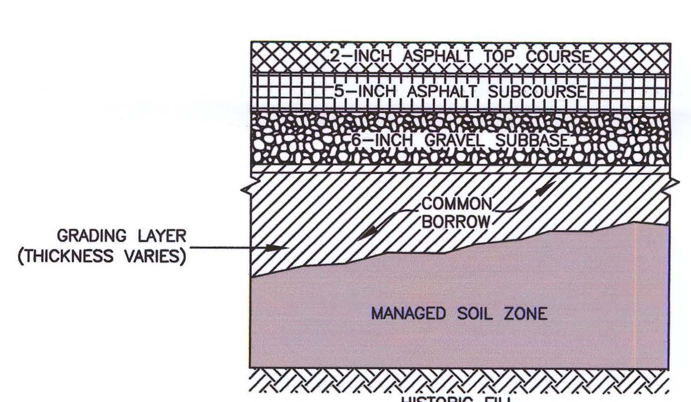
   b. Parking Spaces Defined (40: 5-3): Size: 8.5 ft. x 18.5 ft.
   c. Off-Street Parking (40:5-4) – 3 spaces for the first 3,000 sq. ft of floor space plus 1 space for each additional 500 ft of floor space*.

Square Footage	Parking Stalls
100,000	194
150,000	294
200,000	394
225,000	450

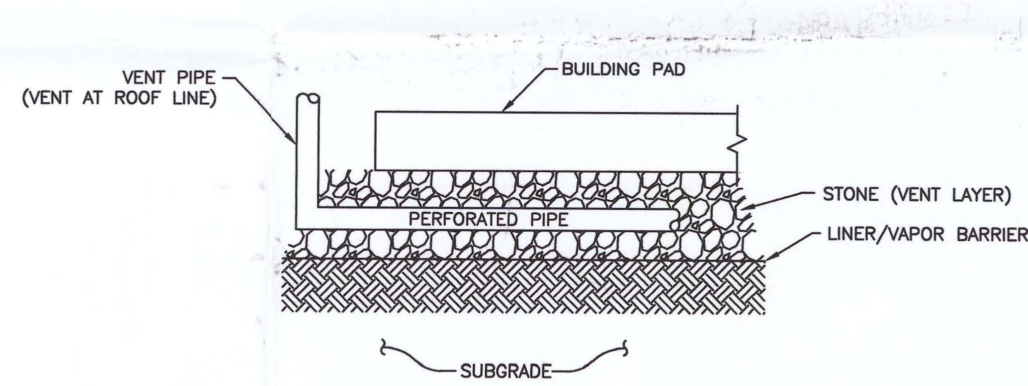
* Variances are acceptable.



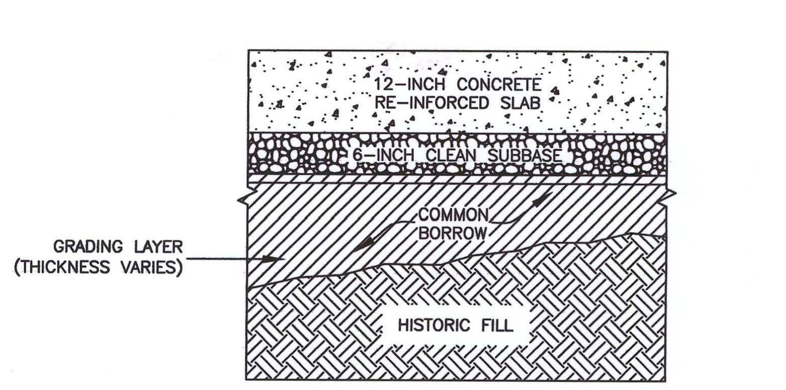
CROSS-SECTION A–A'
HORIZONTAL SCALE 1"=60'
VERTICAL SCALE 1" = 8'



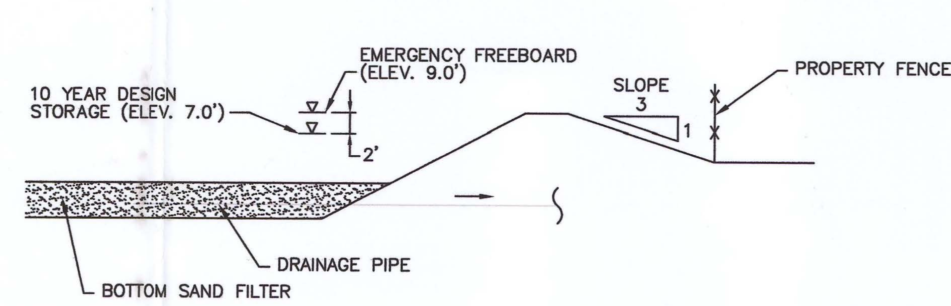
ASPHALT CAP PROFILE
NOT TO SCALE



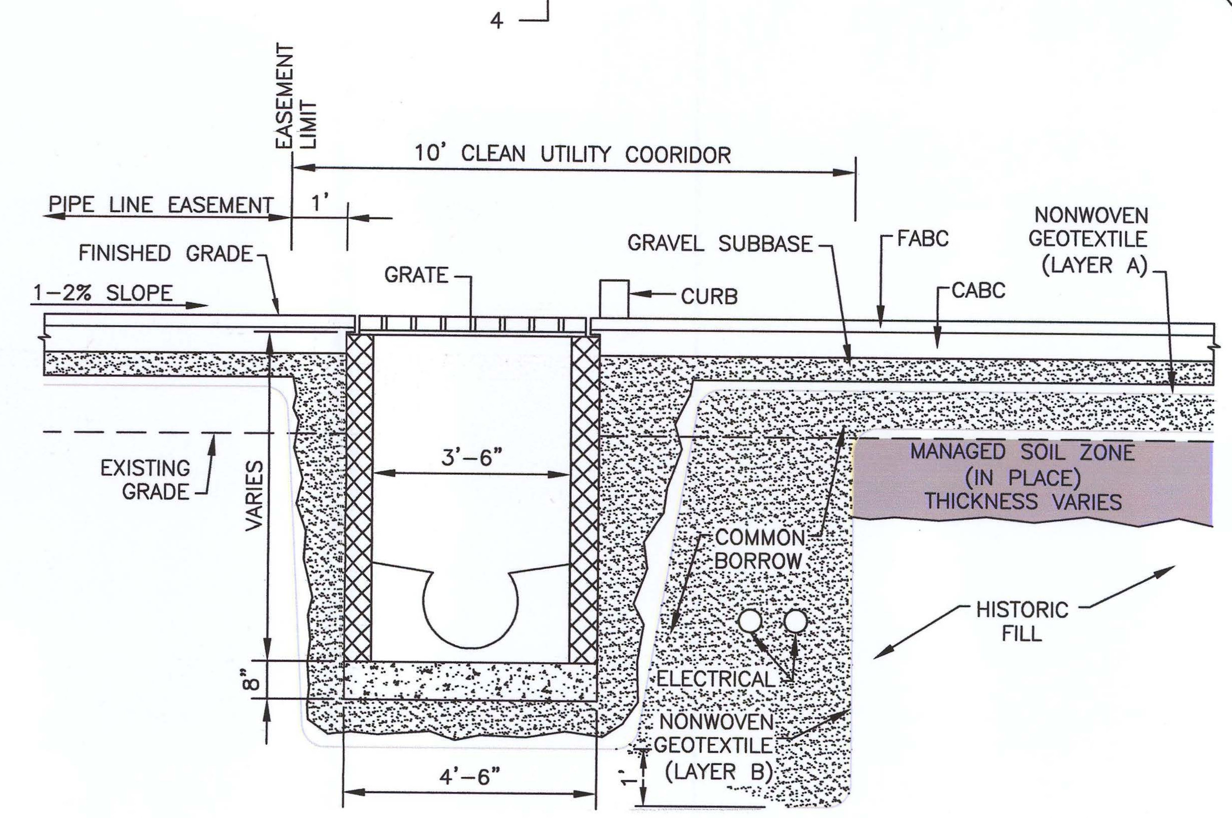
TYPICAL VAPOR MITIGATION SYSTEM
NOT TO SCALE



CONCRETE SLAB CAP PROFILE
NOT TO SCALE



STORMWATER DETENTION BASIN SECTION
NOT TO SCALE



TYPICAL UTILITY COORIDOR
SCALE 3/8" = 1'–0"

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CONCEPTUAL REDEVELOPMENT PLAN

BAYONNE BARREL & DRUM SITE
NEWARK, NEW JERSEY

PROJECT NO.	CHK'D: KS	SCALE: AS SHOWN	DRAWING NO.	REV. NO.
	ENG. LF	CAD FILE NO. BBD-057	3-1	0
	APPVD.	SHEET NO. 1 OF 1		

Appendix A

Focused Human Health Risk Assessment

Focused Human Health Risk Assessment
For the Bayonne Barrel and Drum Site
Newark, New Jersey

Submitted to:

de maximis, Inc.
Clinton, New Jersey

Prepared by:

D'Alleinne and Associates, Inc.
Annandale, New Jersey

22 December 2005

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FOCUSED HUMAN HEALTH RISK ASSESSMENT

EXECUTIVE SUMMARY

The purpose of the Focused Human Health Risk Assessment (FRA) for the Bayonne Barrel and Drum (BB&D) Site is to provide a site-specific human health risk assessment (post-remediation) in support of a proposal for a risk-based polychlorinated biphenyl (PCB) remediation and disposal approval under 40 CFR 761.61 (c) - *Risk-Based Cleanup and Disposal Option*. Under this regulation (i.e., the PCB Mega Rule), no PCBs can be left on site in excess of 100 mg/Kg without receiving a risk-based approval from the US Environmental Protection Agency (USEPA). Since there are no prescribed cleanup standards under this option, the cleanup requirements are determined based on Site contaminants and concentrations, exposure and resulting risk assessment. The results of this FRA will be submitted as part of the Remedial Action Selection report (RASR) to the USEPA and the New Jersey Department of Environmental Protection (NJDEP).

This FRA was developed to assess the potential post-remediation human health risks associated with the site. Following the remediation, the site will be redeveloped for commercial/light industrial uses. Although a specific redevelopment plan is not available at this time, the property is owned by the City of Newark. The City has contracted a redeveloper, BayBar Redevelopment, LLC, who has committed to develop the property for commercial/light industrial use immediately upon completion of the remedy.

The proposed remediation/redevelopment plan for the site includes the following elements relevant to the FRA:

- Principal threat excavation (PTE) and off-site disposal of soils containing greater than 500 mg/Kg of total PCBs. The excavated areas will be backfilled with uncontaminated material.

- Installation of an engineered cap, with a minimum thickness of two feet, consisting of clean soil cover and site redevelopment structures such as building slabs and asphalt pavement.

- Construction of "clean corridors" for utility services and stormwater control.

- Institutional controls (e.g., a Deed Notice) restricting the Site to non-residential use and providing information on site conditions and soil handling procedures for future site work below the cap, if any.

This FRA evaluates the potential human health risks associated with post-remediation conditions for Site chemicals in soil and ground water on a site-wide basis, using methods adapted from those used for Superfund Baseline Risk Assessments (USEPA, 1989).

Conceptual Site Model

Potential contact with subsurface soils underlying the cap may occur during utility repair activities. There are currently gas pipeline easements that traverse a portion of the site. PSE&G owns two pipelines: a 500 psi line and a 30 psi line. Williams Transco owns a separate 750 psi line. Following remediation of the property, activities by workers related to inspection and potential invasive repair of these pipelines could result in contact with soils underlying the cap. During these intermittent activities, these workers may also contact groundwater. Therefore, intermittent incidental contact with soils and groundwater that underlies the cap will be assessed in this FRA.

Consistent with CERCLA baseline risk assessments, this FRA includes two exposure estimates: Reasonable Maximum Exposure (RME) and Central Tendency Exposure (CTE). The RME is defined as the highest reasonable potential exposure that could be expected to occur for a given exposure pathway at a site and is intended to account for both uncertainty in the constituent concentration and variability in the exposure parameters. It is an upper-bound estimate. The CTE is defined as the average exposure to an exposed receptor under typical exposure conditions. It is an estimate reflective of a most likely exposure scenario.

Data Analysis

The chemical database consisted of surface and subsurface soils, and groundwater datasets. This database included analytical results for individual Aroclor PCBs and polychlorinated dibenzo-p-dioxin/polychlorinated dibenzofuran congeners (PCDD/Fs). The Aroclor PCB results were evaluated as Total PCBs and the PCDD/F results were evaluated as Dioxin/Furans TEQ. The 95th Upper Confidence Limit of the mean (95UCL), calculated using the USEPA software ProUCL, were used as the Exposure Point Concentration (EPC). For PCBs and Dioxin/Furans, the principal risk drivers for the site, ProUCL recommended the 99% Chebyshev UCL as the appropriate statistical bases for the EPC. In addition, the use of the average chemical concentration was evaluated as part of the uncertainty assessment to provide a lower bounding estimate of the potential risks.

Soil samples designated as PTE samples are planned for removal and off-site disposal as part of the remediation program. For the calculation of EPCs, the samples designated as PTE samples were replaced with one-half the detection limit, since any excavated materials will be replaced with uncontaminated soils.

Screening of chemicals for inclusion in the FRA was based on frequency of detection, determination of whether the chemical was a Class A carcinogen or not, and comparison of the average chemical concentrations to NJ Class IIA groundwater criteria (for groundwater) or NJ soil screening criteria. An assessment of the use of the maximum results for screening of chemicals in groundwater and soils is evaluated in the uncertainty assessment. Based on this screening process, four chemicals were retained for further analysis in the groundwater (Arsenic, Benzo(a)anthracene, Benzene and Vinyl Chloride) and nine chemicals were retained for further analysis in the soils (Dioxin/Furans, Total PCBs, Aldrin, Arsenic, Lead, Chlordane, Dieldrin, Benzene, and Vinyl Chloride).

Risk Characterization

The potential receptors considered in this quantitative evaluation were Pipeline Inspection/Repair Workers who may have intermittent incidental contact with soils and groundwater underlying the cap during invasive activities. For potential excess lifetime cancer risks, USEPA's acceptable risk range is between one-in-ten-thousand and one-in-a-million (1×10^{-4} to 1×10^{-6}). For potential non-cancer risks, both USEPA and NJDEP use a hazard index benchmark of one. The risk results are summarized in Table ES-1.

Summary of Groundwater Contact Risk Results

For both the CTE and RME Cases, the potential cumulative cancer risks across all chemicals and exposure routes (ingestion and dermal) for groundwater exposure were below 1×10^{-6} (RME Case = 1.2×10^{-7}; CTE Case = 7.5×10^{-8}). Similarly, for both the CTE and RME Cases, the potential cumulative non-cancer risks across all chemicals and exposure routes (ingestion and dermal) for groundwater exposure were below the threshold hazard index of 1.

Summary of Soil Contact Risk Results

For both the CTE and RME Cases, the potential cumulative cancer risks across all chemicals and exposure routes (ingestion, dermal and inhalation) for soil were below 1×10^{-6} (RME Case = 7.5×10^{-7}; CTE Case = 4.5×10^{-7}). Similarly, for both the CTE and RME Cases, the potential cumulative non-cancer risks across all chemicals and exposure routes (ingestion, dermal and inhalation) for subsurface soil exposure were below the threshold hazard index of 1.

Risk Management Conclusions

Based on this assessment, the chemicals remaining in the groundwater and soil will not pose a significant cancer or non-cancer risk to the evaluated receptors under the assumed exposure conditions associated with the proposed remediation/redevelopment plan as presented in the RASR. Accordingly, this assessment demonstrates that the selected remediation/redevelopment plan is protective and does not present unreasonable risk to human health and safety. Furthermore, the proposed remediation/redevelopment plan conforms to N.J.S.A.58:10B-12(d)(1) and (2) for achieving risk-based levels of 1 x 10^{-6} excess cancer risk and a non-carcinogen hazard index of 1.

Table ES-1. Bayonne Barrel and Drum - Summary of Potential Risk Results (Excluding Lead) for the Inspection/Repair Worker for All Evaluated Exposure Pathways

Case	Area	Groundwater-Based		Soil-Based	
		Potential Cancer Risks	Potential Non-Cancer Risks	Potential Cancer Risks	Potential Non-Cancer Risks
RME	Site-Wide	1.2E-07	0.00012	7.5E-07	0.066
CTE	Site-Wide	7.5E-08	0.00012	4.5E-07	0.066

Notes:
Risk results combine all exposure pathways and evaulated chemicals and were calculated using the UCLs as EPCs.
Potential groundwater and soil risks were evaluated on a site-wide basis.
For potential cancer risks a value greater than 1E-6 is above the threshold value. These are shown in bold.
For pontential non-cancer risks a value greater than one is above the threshold value. These are shown in bold.

1.0 INTRODUCTION

The purpose of the Focused Human Health Risk Assessment (FRA) for the Bayonne Barrel and Drum (BB&D) Site is to provide a site-specific human health risk assessment (post-remediation) in support of a proposal for a risk-based polychlorinated biphenyl (PCB) remediation and disposal approval under 40 CFR 761.61 (c) - *Risk-Based Cleanup and Disposal Option*. Under this regulation (i.e., the PCB Mega Rule), no PCBs can be left on site in excess of 100 mg/Kg without receiving a risk-based approval from the USEPA. Since there are no prescribed cleanup standards under this option, the cleanup requirements are determined based on Site contaminants and concentrations, exposure and resulting risk assessment. The results of this FRA will be submitted as part of the Remedial Action Selection report (RASR) to the USEPA and the NJDEP.

1.1 Site Background

The BB&D Site is located at 148-150 Raymond Boulevard in Newark, New Jersey (Figure 1). A detailed discussion of the BB&D Site history is presented in the Remedial Action Selection Report (Quest, 2005). Briefly, BB&D operated as a metal barrel and drum reconditioning facility from the early 1940s until the early 1980s. As part of the process, caustic cleaning solution was used, generating a liquid waste. Ash waste from an on-site incinerator and sludge were stored at the site, as well as numerous drums and other items. Prior investigations have shown that soils at the BB&D Site contain PCBs, polychlorinated dioxins/polychlorinated furans (PCDD/Fs), metals, pesticides, semi-volatile organic compounds (SVOCs) and volatile organic compounds (VOCs) at concentrations that exceed NJ Non-Residential Direct Contact Soil Cleanup Criteria (NRDSCC). Groundwater (GW) contains primarily VOC's, and of less significance, metals and SVOCs.

1.2 FRA Approach

This FRA was developed to assess the potential post-remediation human health risks associated with the site. Following the remediation, the site will be redeveloped for commercial/light industrial uses, although specific redevelopment plans were not available at the time of the preparation of the FRA.

The proposed remediation/redevelopment plan for the site includes the following elements relevant to the FRA:

- Principal threat excavation (PTE) and off-site disposal of soils containing greater than 500 mg/Kg of total PCBs. The excavated areas will be backfilled with uncontaminated material.

- Installation of an engineered cap, with a minimum thickness of two feet, consisting of clean soil cover and site redevelopment structures such as building slabs and asphalt pavement.

- Construction of "clean corridors" for utility services and stormwater control.

- Institutional controls (e.g., a Deed Notice) restricting the Site to non-residential use and providing information on site conditions and soil handling procedures for future site work below the cap, if any.

This FRA evaluates the potential human health risks associated with post-remediation/redevelopment conditions for residual Site chemicals in soil and ground water using methods adapted from those used for Superfund Baseline Risk Assessments (USEPA, 1989). Current toxicity information, standard and site-specific exposure parameters have been used. The rationale for the use of site-specific exposure assumptions is described in this report.

The following guidance documents were used in conducting the FRA:

- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A) - Interim Final. (USEPA, 1989);

- Final Guidelines for Exposure Assessment (USEPA, 1992a);

- Guidance on Risk Characterization for Risk Managers and Risk Assessors (USEPA, 1992b);

- Guidance for Risk Characterization (USEPA, 1995a);

- Exposure Factors Handbook (USEPA, 1997a);

- Proposed Guidelines for Carcinogen Risk Assessment – Interim Final (USEPA, 1999);

- Risk Assessment Guidance for Superfund Volume I, Part E. Supplemental Guidance for Dermal Risk Assessment (USEPA, 2004b);

- Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, Peer Review Draft, (USEPA, 2001b); and

- Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (USEPA, 2002a).

The six components of the FRA, contained in Sections 2 through 7 of this report, are:

1. Conceptual Site Model - review available information to ensure that it is adequate to complete the FRA; identify constituent sources, potentially impacted media, receptors that could come into contact with those media, and complete exposure pathways for each of those receptors;

2. Data Analysis - develop summary statistics for appropriate data, screen to identify constituents of potential concern (COPCs) for human receptors, and select appropriate exposure point concentrations (EPCs) for each COPC;

3. Exposure Assessment - select appropriate equations and parameters to estimate average daily chemical intakes for all complete exposure pathways;

4. Toxicity Assessment - identify chemical dose-response relationships and daily intake levels at which no adverse effects or unacceptable cancer risks can reasonably be anticipated to result and select appropriate toxicity indices for each COPC;

5. Risk Characterization - compare average daily chemical intake levels with appropriate toxicity indices to generate quantitative expressions of hazard (for non-carcinogenic effects) and the upper limits of the potential cancer risk (for the carcinogenic endpoint) for each COPC; and,

6. Uncertainty Analysis – Qualitatively and quantitatively assess the uncertainty inherent in the key components of the FRA in order to provide proper perspective to risk management decision-makers.

The following sections describe the steps listed above to evaluate the potential for human health risks following remediation/redevelopment of the Site.

2.0 CONCEPTUAL SITE MODEL

The Conceptual Site Model is a formal process for outlining preliminary hypotheses about potential exposure resulting from Site-related COPCs. It uses previously collected information to identify complete exposure pathways. Only complete pathways have the potential to lead to exposure and a potential risk. Complete pathways are defined by four components; if any one of the components is missing, the pathway is considered incomplete, and therefore no risk can be associated with that pathway. These components are:

1. A source and mechanism of chemical release (e.g., spills);
2. A retention or transport medium (e.g., soil or groundwater);
3. A point of potential contact with the impacted medium, referred to as the exposure point (e.g., exposed surface soils); and
4. An exposure route (e.g., dermal contact with impacted soils).

Figure 2 illustrates the potential post-remedy human health exposure pathways potentially complete at the Site, respectively. Explanations for the rationale behind the selection of impacted media, potentially exposed receptors to these media, and their potential routes of exposure follow.

2.1 Media

A detailed assessment of the chemicals present at the BB&D Site is presented in the Remedial Investigation Report (Quest, 2005). This section will briefly summarize the media-specific analytical data that were used for the FRA. An MS-Access database was developed that includes the analytical results from multiple prior investigations at the Site.

Groundwater:

A total of 15 wells with finished depths ranging from 6 to 38 feet were sampled for VOCs, SVOCs, pesticides, metals, and Aroclor PCBs. The analytical results used for this FRA were from groundwater samples collected from 26 to 28 July 2004. These included the collection of one sample duplicate. No distinction with collection depth was made for this FRA.

Soils:

Soil samples were collected from one or more depths from a total of 328 locations. A total of 37 different soil depth intervals were represented in the database. Three depth intervals (0 to 0.5, 0 to 2, and 2 to 2.5 feet) represented approximately half of the collected samples. The maximum depth sampled was 18.5 feet. Soil samples were analyzed for VOCs, SVOCs, pesticides, metals, TPH, Aroclor PCBs, and PCDD/Fs.

2.2 Receptors

The objective of the FRA is to estimate potential risk to future receptors that might contact soils or groundwater following remediation/redevelopment of the site. The potential receptors at the BB&D site that may be exposed to residual contaminants in soil and groundwater are summarized in Tables 1 and 2, respectively, and discussed below.

Potential Contact with Surface and Subsurface Soils (Table 1)

Under the post-remediation/redevelopment conditions for exposure to soils, the following candidate receptors were considered: Resident, Site Employee, Site Visitor (e.g., customer), and Utility Inspector/Repair Worker. There is no current on-site residential land use at the Site and it is not zoned for residential use, nor is there any residential land use within the immediate vicinity of the Site. The Site was an active industrial facility from the early 1940s until the early 1980s and is bounded by the New Jersey Turnpike and other major roadways (Figure 1). Therefore, a residential receptor is not appropriate for evaluation in this FRA. Site Employees and Site Visitors were excluded from the analysis because the site will be capped during remediation/redevelopment preventing any contact with subsurface soils that may contain COPCs.

The only existing utilities on site are associated with the gas pipeline easements, and all future utilities will be installed in clean corridors as part of the remediation/redevelopment plan. Therefore, the only potential receptor is the Pipeline Inspector/Repair worker who might have contact with subsurface soils following a disturbance or breach of the cap integrity during a repair event. This is the primary receptor evaluated in the FRA.

Potential Contact with Groundwater (Table 2)

The following candidate receptors were considered for potential contact with Site groundwater: Resident, Site Employee, Site Visitor and Utility Inspector/Repair Worker. The Resident, Site Employee and Site Visitor are not appropriate receptors to evaluate since the municipality provides potable water to the area and future development of groundwater for potable use at the Site is highly unlikely. Pipeline Inspector/Repair Workers might contact groundwater during invasive activities and were therefore retained as receptors for this evaluation.

In summary, based on the planned remediation/redevelopment and the associated institutional controls, the following potential exposure pathways and scenarios are identified:

- Pipeline Inspector/Repair Worker scenario (utility worker) during repair of underground utilities (e.g., gas pipeline repair); evaluation of dermal exposure, incidental ingestion, and inhalation of surface and subsurface soils, and dermal exposure and incidental ingestion of groundwater.

2.3 Complete Exposure Pathways

Two types of exposure pathways are generally considered in Human Health Risk Assessments: direct and indirect. A direct exposure pathway is complete when a receptor comes into direct contact with the impacted media (i.e., dermal contact or ingestion). An indirect exposure occurs when the COPC is transferred from the originally impacted medium (e.g., soil) to another medium (e.g., air), which is subsequently contacted by a human receptor. Identification of complete exposure pathways for each receptor is discussed separately for each medium below.

2.3.1 Surface and Subsurface Soils

The direct soil exposure pathways for post-remediation/redevelopment property conditions are dermal contact and incidental ingestion of surface and subsurface soils.

Two indirect soil exposure pathways – dust inhalation and release of volatile organics from the soils to the overlying air – were evaluated for surface and subsurface soils. Dust inhalation of soils containing COPCs is unlikely following site remediation/redevelopment because the cap will serve as an effective barrier under non-invasive, undisturbed conditions. Some dust entrainment into the air might occur with the invasive post-remediation/redevelopment activities by the Pipeline Inspector/Repair Workers and therefore this exposure pathway was evaluated for this receptor group.

Inhalation of volatile constituents migrating from vadose zone soils into the overlying outdoor air is considered to be a *de minimis* exposure pathway due to low concentrations, and was not evaluated since any vapors would be rapidly diluted in the overlying air. Indoor air is similarly considered to be a *de minimis* exposure pathway because a vapor barrier or sub-slab ventilation system will be incorporated into the redevelopment design to mitigate the potential for vapor intrusion.

While uptake by plants and animals that are subsequently ingested by humans is possible when COPCs are present in surface soils, these exposure pathways are not complete for the industrial setting of this property. Thus, these pathways are not evaluated further in this FRA.

2.3.2 Groundwater

Groundwater is currently not used as a potable source at the Site or vicinity. Due to the industrial nature of the area, and the availability of municipal water/sewer services, it is also unlikely to be used as a potable source in the future. Therefore, direct contact via incidental ingestion and dermal contact of groundwater was only evaluated for the Pipeline Inspector/Repair workers.

Examples of indirect groundwater exposure pathways are inhalation of volatile constituents migrating from groundwater to outdoor or indoor air. Outdoor air exposure is considered to be a *de minimis* exposure pathway since there would be rapid dilution of any emitted volatile compounds in the overlying air. Indoor air is similarly considered to be a *de minimis* exposure pathway because a vapor barrier or sub-slab ventilation system will be incorporated into the redevelopment design to mitigate the potential for vapor intrusion.

Finally, indirect exposure to groundwater containing COPCs, such as transfer from groundwater to plants that are then consumed by residents, was considered to be an incomplete exposure pathway since the site is currently industrial/commercial and municipal potable water is available.

3.0 DATA ANALYSIS

3.1 Calculation of Multi-component Mixtures

The Aroclor PCBs and PCDD/F congeners are multi-component mixtures that are evaluated in slightly different ways for risk assessments than other chemicals. The dominant Aroclor PCBs in soils from the BB&D Site were Aroclor-1248, Aroclor-1254, and Aroclor-1260, but they are typically evaluated on a "Total PCB" basis in human health risk assessments. The total PCBs were calculated on an individual sample basis by summing the individual Aroclor PCB results and setting any non-detect Aroclor results to zero.

The PCDD/F congeners are evaluated using the toxic equivalence quotient (Dioxin-TEQ) method. The Dioxin-TEQ concentrations were calculated by multiplying the observed concentration for each PCDD/F congener by the mammalian toxic equivalence factor (TEF) reported in van den Berg et al (1998) and then summing across the congeners in each sample. TEFs represent the relative toxic potency of the PCDD/F congener relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin. TEQs were calculated by setting any non-detect congener results to zero.

3.2 Statistical Analysis

For purposes of the calculation of summary statistics (e.g., averages) used to support the FRA, the following procedures were used for the Total PCBs, Dioxin/Furans and remaining individual chemicals:

- All non-detect results were set to one-half their reported detection limits;
- Field duplicates were treated as independent samples for all calculations; and
- Soil data from multiple depths within the same boring were treated as independent samples (i.e., no integration of depth).

Groundwater, surface soil, and the combined surface and subsurface soils were evaluated as separate data sets. The key summary statistics are presented as part of the EPC data summaries discussed in Section 3.3.

3.3 Calculation of the Exposure Point Concentration

The Exposure Point Concentration (EPC) is a constituent-specific and media-specific estimate of the average concentration that a given receptor may potentially contact. Since there is uncertainty in the representativeness of the site sampling program, EPA guidance recommends the use of the Upper 95th Confidence Limit (UCL) of the mean concentration (USEPA, 2002a). These were calculated using USEPA-developed software ProUCL (version 3; USEPA, 2004c). As part of the uncertainty assessment, use of the average chemical concentrations are also assessed to provide a lower bounding estimate on the calculated risks.

PTE soils are planned for removal and off-site disposal as part of the remediation/redevelopment program. For the calculation of EPCs, sample results in the PTE area are conservatively replaced with one-half the detection limit, because any excavated materials will be replaced with uncontaminated soils. Based on review of the analytical results, the following detection limits were used for PTE soil replacement samples:

- Total PCBs: 0.2 mg/Kg
- Dioxin/Furans: 0.2 µg/Kg
- Arsenic: 1 mg/Kg
- Lead: 1 mg/Kg
- Benzene: 0.2 mg/Kg
- Aldrin: 0.04 mg/Kg
- Dieldrin: 0.04 mg/Kg

ND surrogates were not required in the PTE excavation areas for vinyl chloride or chlordane since these COPCs were either not detected in the PTE samples or there were no samples were these COPCs were analyzed that corresponded to any PTE samples. When the analyte was reported in a PTE sample as a non-detect, the reported detection limit was conservatively used as input for the EPC calculations.

The EPCs are summarized by media, location and scenario in Tables 7a, and 7b. In several cases the mean EPCs could not be calculated due to elevated detection limits relative to the observed positive results. In these cases (e.g., benzene in surface soils) the maximum positive result was used as the EPC.

PTE removal results in a reduction of the Dioxin/Furan-TEQ and total PCB soil concentrations to the values shown in the table below.

Parameter	Units	Mean Conc	UCL Conc
Total PCBs	mg/Kg	31.8	66.6
Dioxin/Furan TEQ	µg/Kg	5.29	13.5

3.4 Screening of Constituents

Chemicals detected in the soils and groundwater samples were screened prior to performing any risk calculations. Chemicals were screened using the following procedure:

- Frequency of Detection Screen - minimum detection frequency of 5% is required for retention in the FRA unless chemical is considered to be a Class A carcinogen
- For groundwater, compare the average concentration[1] to the NJ GW - Class IIA groundwater criteria. If the latter is exceeded, retain chemical for further analysis.
- For soils, compare the average concentration to the NJ Non-Residential Direct Contact Soil Cleanup Criteria (NJDEP, 1999). If the latter is exceeded, retain chemical for further analysis.
- For metals in soils or groundwater, compare to regional background. If value is above regional background retain for further analysis.
- If chemical is a nutrient, assess whether chemical is at reasonable concentrations, either consistent with typical background or at levels reasonable from a nutrition perspective.
- Any Class A carcinogens are retained for further analysis.

Chemicals that are screened out of the FRA are unlikely to contribute significantly to the potential risks at the property or contribute to the risk management decisions made for the property.

3.4.1 Groundwater Screening Results

The following procedures were used for screening the groundwater data:

[1] An assessment of the use of the maximum results for screening of chemicals in groundwater and soils is evaluated in the uncertainty assessment (Section 7.2.1).

- For calculating summary statistics the non-detect values were replaced with one-half the detection limits.
- Any field duplicate results were handled as individual values for these calculations.
- Results from all monitoring wells and sampling events were combined for this screen.

The screening steps are shown in Table 5 for the groundwater samples. Chemicals that were not detected in any of the monitoring well samples (e.g., PCBs) were excluded from this table. Based on this screen, four chemicals were retained for further analysis as GW COPCs: arsenic, benzo(a)anthracene, benzene, and vinyl chloride. Arsenic, benzene, and vinyl chloride are considered Class A carcinogens.

3.4.2 Soil Screening Results

The following was performed prior to performing the soil screening:

- For calculating summary statistics the non-detect values were replaced with one-half the detection limits.
- Any field duplicate results were handled as individual values for these calculations.
- Samples from multiple depths from the same soil boring locations were handled as individual values for these calculations.

The screening steps and results are shown in Table 6. Chemicals that were not detected in any of the soil samples (e.g., chloroethane) were excluded from this table. Based on this screen, nine chemicals were retained for further analysis as soil COCs: Total PCBs, PCDD/F TEQs, two metals (arsenic and lead), three pesticides (aldrin, chlordane and dieldrin), two volatile organic compounds (benzene and vinyl chloride), and total petroleum hydrocarbons. Arsenic, chlordane, benzene, and vinyl chloride are considered Class A carcinogens. Of these, vinyl chloride did not meet the 5% detection frequency.

Total petroleum hydrocarbons were not assessed further in the FRA due to the lack of suitable risk assessment benchmarks for this complex mixture of petroleum chemicals. Lead will be assessed in the context of the EPA Adult Lead Model (ALM).

4.0 EXPOSURE ASSESSMENT

4.1 Exposure Calculations

The objective of the exposure assessment is to estimate the type, magnitude, frequency, and duration of exposures for complete exposure pathways via intake equations. Chemical intake is expressed as the amount of the constituent at the exchange boundaries of an organism (e.g., skin, lungs, and digestive tract) that is available for systemic absorption. Chemical intake is also referred to as the average daily dose (ADD) and is usually expressed in milligrams (mg) per kilogram (Kg) of body weight of the receptor per day. The equations for estimating a receptor's potential ADD are presented below, and the exposure parameters used are discussed in the following paragraphs.

Dermal Contact with Groundwater

The following equation was used to evaluate potential exposure resulting from dermal contact with groundwater by Inspection/Repair Workers.

$$ADD = \frac{EPC_{gw} \times SA \times KP \times ET \times EF \times ED \times CF}{BW \times AT}$$

Where:

ADD	=	Average Daily Dose due to groundwater dermal contact (mg/Kg-day)
EPC_{gw}	=	Exposure Point Concentration in groundwater (mg/liter)
SA	=	Exposed skin surface area (cm^2)
KP	=	Chemical-specific permeability coefficient value (cm/hour)
ET	=	Exposure time (hours/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
CF	=	Conversion factor (liter/cm^3)
BW	=	Body weight (Kg)
AT	=	Averaging time (days)

Incidental Ingestion of Groundwater

The following equation was used to evaluate potential exposure resulting from the incidental ingestion of groundwater by Inspection/Repair Workers.

$$ADD = \frac{EPC_{gw} \times IR \times FR \times OA \times EF \times ED}{BW \times AT}$$

Where:

ADD	=	Average Daily Dose due to groundwater ingestion (mg/Kg-day)
EPC_{gw}	=	Exposure Point Concentration in groundwater (mg/liter)
IR	=	Ingestion rate (liters/day)
FR	=	Fraction of water ingested that is contaminated (unitless)
OA	=	Oral absorption (fraction of COPC absorbed by GI tract) (unitless)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Soil Ingestion

The following equation was used to evaluate potential exposure resulting from the incidental ingestion of soils by the Inspection/Repair Workers.

$$ADD = \frac{EPC_S \times IR_s \times OA \times FR \times EF \times ED \times CF}{BW \times AT}$$

Where:

ADD	=	Average Daily Dose Due to Soil Ingestion (mg/Kg-day)
EPC_S	=	Exposure Point Concentration in Soil (mg/Kg)
IR_S	=	Soil/ Ingestion Rate (mg/day)
OA	=	Oral absorption factor (unitless)
FR	=	Fraction of soil ingested that is contaminated (unitless)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
CF	=	Unit Conversion Factor (1×10^{-6} Kg/mg)
BW	=	Body Weight (Kg), and
AT	=	Averaging Time (days).

Dermal Contact with Soil

The following equation was used to evaluate potential exposure resulting from the dermal contact of soils by Inspection/Repair Workers.

$$ADD = \frac{EPC_S \times SSAF \times SA \times DAF \times EF \times ED \times CF}{BW \times AT}$$

Where:

ADD	=	Average Daily Dose Due to Dermal Contact with Soil (mg/Kg-day)
EPC_S	=	Exposure Point Concentration in Soil (mg/Kg)
SSAF	=	Skin Surface Adherence Factor (mg/cm^2)
SA	=	Skin Surface Area Exposed (cm^2/day)
DAF	=	Dermal Relative Absorption Factor (unitless)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
CF	=	Unit Conversion Factor ($1x10^{-6}$ Kg/mg)
BW	=	Body Weight (Kg), and
AT	=	Averaging Time (days).

Inhalation of Soils

The following equation was used to evaluate potential exposure resulting from the dust inhalation by Inspection/Repair Workers.

$$ADD = \frac{EPC_s \times RPM \times ET \times AF \times IhR \times EF \times ED \times CFI}{BW \times AT}$$

Where:

ADD	=	Average Daily Dose Due to Inhalation (mg/kg-day)
EPC_S	=	Exposure Point Concentration in Soil (mg/Kg)
RPM	=	Respirable Particulate Matter (µg /m^3)
IhR	=	Inhalation Rate (m^3/hr)
ET	=	Exposure Time (hr)
AF	=	Absorption Efficiency (unitless)
EF	=	Exposure Frequency (days/year),
ED	=	Exposure Duration (years),
CFI	=	Conversion Factor for Inhalation (Kg/µg)
BW	=	Body Weight (kg), and
AT	=	Averaging Time (days).

The EPCs used in the ADD calculations are shown in Tables 7a (groundwater) and Table 7b (soils).

4.2 Exposure Assumptions

The exposure assumptions for each of these receptors were developed based on an understanding of likely contact potential following remediation/redevelopment of the BB&D

property. The groundwater-based exposure assumptions are summarized in Table 3 and the soil-based exposure assumptions are summarized in Table 4.

Consistent with CERCLA baseline risk assessments, this FRA includes two exposure estimates: Reasonable Maximum Exposure (RME) and Central Tendency Exposure (CTE). The RME is defined as the highest reasonable potential exposure that could be expected to occur for a given exposure pathway at a site and is intended to account for both uncertainty in the constituent concentration and variability in the exposure parameters. It is an upper-bound estimate. The CTE is defined as the average exposure to an exposed receptor under typical exposure conditions. It is an estimate reflective of a most likely exposure scenario.

The exposure assumptions presented below were developed to reflect both the CTE and RME exposure conditions.

4.2.1 Pipeline Inspection/Repair Worker

Exposure parameters and assumptions used to evaluate the Pipeline Inspection/Repair Workers are provided in Table 3 for groundwater and Table 4 for soils. Non-invasive inspections of the soil cap occur routinely but do not result in a complete exposure pathway. The design lifetime of a gas pipeline exceeds 50 years. Based on discussions with owners of the pipelines (Williams Transco and PSE&G), an extremely conservative assumption considers that during that 50-year lifetime, invasive repair activities might occur at a frequency of once every 15 years (Attachment 1). A 4-day repair period was assumed to occur during these events (i.e., 4 days/event). During these repair events, it was further assumed that the waste material underlying the cap would be contacted about 25% of the time. In assessing the potential cancer and non-cancer risks, the cancer risk is weighted over the entire lifetime while the non-cancer risk is weighted over an annual basis.

For both the CTE and RME potential cancer risk cases, the exposure frequency would be the following:

$$EF = \frac{4 \text{ days}}{\text{event}} \times \frac{1 \text{ event}}{15 \text{ year}} \times 0.25 = 0.07 \text{ day/year}$$

The exposure duration for the CTE and RME cases were assumed to be 10 and 25 years, respectively. The 10 year period is similar to the median job tenure reported for "Inspectors, testers, and graders" in the USEPA *Exposure Factors Handbook* (USEPA, 1997a). The RME period of 25 years was consistent with the exposure duration period for utility workers from USEPA (2004b). The body weight (71.8 Kg) was from USEPA (1997a).

Non-cancer risks were averaged over a year rather than averaging over the exposure duration (which is more typically done), due to the infrequent nature of the exposure (1 event every 15 years). If averaged over the duration, the calculated non-cancer risks would have been inappropriately "diluted". As stated above, each repair event occurs over a 4-day period. Therefore, the exposure frequency for non-cancer risks is assumed to be:

$$EF = \frac{4 \text{ days}}{\text{event}} \times \frac{1 \text{ event}}{\text{year}} \times 0.25 = 1 \text{ day/year}$$

No distinction between CTE and RME exposure frequencies is required due to the annualized estimate.

Groundwater Exposure Assumptions (Table 3)

Incidental ingestion of groundwater during any construction or maintenance activities was assumed to be 25 mL/day. This value was developed based on professional judgment and represents about 1% of a normal potable water ingestion rate. The permeability coefficients used to assess dermal uptake from groundwater contact are chemical-specific and were obtained from RAGS Part E, Exhibits B-3 (organics) and B-4 (inorganics) of USEPA (2004a) or an on-line database (Table 8). USEPA has not developed recommended surface areas for the assessment of incidental dermal contact with groundwater. The potential skin surface was assumed to be 2,733 cm^2, which represents the sum of the median values for face, forearms, and hands reported for adult males in RAGS Part E, Exhibit C-1 (USEPA, 2004a).

Soil Exposure Assumptions (Table 4)

The skin surface area used to assess potential dermal uptake during any inspection or maintenance activities was 3,300 cm^2, which is the default value recommended in Exhibit 1-2 of USEPA (2001a) for commercial, industrial or construction workers. A dermal adherence factor of 0.3 mg/cm^2 was assumed based on information presented in Exhibit C-3 of USEPA (2004a). This value was the 95th percentile value from this table. The dermal absorption factors are chemical-specific and were obtained from RAGS Part E, Exhibit 4-1 (USEPA, 2004a).

The incidental soil ingestion rate was assumed to be 330 mg/day and was obtained from Exhibit 1-2 of USEPA (2001a). The oral absorption factors are chemical-specific and were obtained from RAGS Part E, Exhibit 4-1 (USEPA, 2004a).

For the dust inhalation exposure the ambient dust concentrations could have been calculated, derived from empirical data, or assumed. USEPA's *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (USEPA, 2001b) provides a methodology for calculating PM_{10} levels in air during activities such as excavation. Empirical data are available from New

Jersey. NJDEP reported PM_{10} concentrations ranging from 21.7 to 37.4 μg/m^3 at 10 monitoring locations in the state (NJDEP, 2001)[2]. However, for conservatism, the air concentration of dusts was assumed to be at the maximum allowable 24-hour PM_{10} concentration of 150 μg/m^3 (NJDEP, 2001). The inhalation rate of 1.5 m^3/hour was the rate for outdoor workers engaged in moderate activity reported in USEPA (1997a).

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[2] The ten NJDEP air monitoring stations included two in Atlantic City, two in Camden, and one each in Elizabeth, Fort Lee, Jersey City, Newark, Pennsauken, and Trenton. Additional information is available at http://www.state.nj.us/dep/airmon/part01.pdf

5.0 TOXICITY ASSESSMENT

Toxicity assessment involves the evaluation of available toxicity information to determine acceptable non-carcinogenic and carcinogenic thresholds. Toxicity benchmarks can be used to estimate adverse effects in individuals exposed to COPCs.

Exposure to a chemical does not necessarily result in adverse effects. The relationship between dose and response defines the quantitative indices of toxicity required to evaluate the potential health risks associated with a given level of exposure. If the nature of the dose-response relationship is such that no effects can be demonstrated below a certain level of exposure, a threshold can be defined and an acceptable exposure level derived. Humans are routinely exposed to naturally occurring non-nutritive chemicals and man-made chemicals at low levels (e.g., typical diet, air, and drinking water) with no apparent adverse effects. However, the potential for adverse effects may occur if the exposure level exceeds the threshold. This threshold applies primarily to chemicals that may produce non-carcinogenic effects, although some evidence suggests that exposure thresholds may exist for certain carcinogenic constituents as well. EPA's current approach to assessing carcinogenic risk assumes that any level of exposure to most carcinogens results in some level of potential cancer risk.

Adverse effects can be caused by acute or subchronic exposure, which is single or short-term exposure to a substance, or by chronic exposure to lower levels of a substance on a continuous or repeated basis over an extended period of time. "Acceptable" subchronic or chronic levels of exposure are considered to be without any anticipated adverse effects. An acceptable exposure level, called a Reference Dose (RfD), is calculated to provide an "adequate margin of safety." RfDs are toxicity values used to estimate potential risk for non-carcinogenic effects. For constituents with potential non-carcinogenic effects, the RfD provides reasonable certainty that if the specified exposure dose is below the RfD, then no non-carcinogenic health effects are expected to occur even if daily exposure were to occur for a lifetime. RfDs are expressed in terms of milligrams of constituent per kilogram of body weight per day (mg/Kg-day).

The underlying assumption of regulatory risk assessment for constituents with known or assumed potential carcinogenic effects is that no threshold dose exists. In other words, it is assumed that a finite level of risk is associated with any dose above zero. For carcinogenic effects, EPA uses a two-step evaluation in which the constituent is assigned a weight-of-evidence classification, and then a cancer slope factor (CSF) is calculated. The weight-of-evidence classification summarizes the evidence about the likelihood of the constituent being a human carcinogen. Group A constituents are classified as human carcinogens, Group B constituents are probable human carcinogens, Group C constituents are possible human carcinogens, Group D constituents are not classifiable as to human carcinogenicity, and for Group E constituents there is evidence of non-carcinogenicity for humans. In the second part of the evaluation, CSFs are calculated for constituents that are known or probable human carcinogens. The EPA has developed computerized models that extrapolate observed responses at high doses used in animal studies to predicted responses in humans at the low doses encountered in environmental situations. The models developed by the EPA assume no threshold and usually use animal as well as human data to develop an estimate of the carcinogenic potency of a constituent. The models used by EPA assume that carcinogenic dose-response is linear at low doses. The appropriate toxicity value to address carcinogens is a CSF.

A number of sources of toxicity information exist, and these sources vary with regard to the availability and strength of supporting evidence. USEPA established a protocol for determining toxicity factors that defines a hierarchy of sources to be consulted and the methodology for selection of toxicity values (USEPA, 2003a). This protocol was developed in accordance with current USEPA methodology adopted and/or developed by the National Academy of Sciences. Oral and inhalation toxicity values according to the following hierarchy of sources was employed:

1. Toxicity values were obtained from the *Integrated Risk Information System* (IRIS) database when possible. This database contains RfDs and CSFs verified by EPA's RfD and Carcinogen Risk Assessment Verification Endeavor workgroups, and thus is the agency's preferred source for toxicity values. IRIS supersedes all other information sources.

2. For COPCs with no toxicity values available on IRIS, EPA's Provisional Peer Reviewed Toxicity Values (PPRTV) can be used[3]. PPTVs were not required for any of the COPCs for this FRA.

3. For COPCs with no toxicity values available from IRIS or as PPRTVs, values provided in the Health Effects Assessment Summary Tables (HEAST; USEPA, 1997b) can be used. HEAST contains interim, as well as verified, RfDs and CSFs. Supporting toxicity information for verified values is provided in an extensive reference section of HEAST. None of the HEAST RfDs and CSFs were required for this FRA.

Currently, the EPA has a methodology available for deriving dermal toxicity values but has not published toxicity values to be utilized in dermal exposure scenarios in typical sources such as

[3] These values have been developed by the Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (STSC). The STSC develops PPRTVs on a chemical-specific basis when requested to do so under EPA's Superfund program (USEPA, 2003a). This information is at the following secure website accessible only by USEPA and their designees: http://hhpprtv.ornl.gov/pprtv_papers.shtml.

IRIS and HEAST. Instead, dermal exposures are generally evaluated using oral RfDs and CSFs with adjustments made for certain compounds to reflect the difference in absorption via the differing exposure routes (USEPA, 2004a). This approach was used in this FRA. All RfDs and CSFs used in evaluating potential risks and hazards are presented in Table 9.

6.0 RISK CHARACTERIZATION

Risk characterization is the step in the risk assessment process that combines the results of the exposure assessment and the toxicity assessment for each COPC to estimate the potential for cancer and non-cancer human health effects from chronic exposure to that constituent. The estimated potential cumulative non-cancer and cancer risks to human health from Site-related COPCs are summarized below.

6.1 Methodologies

Non-Cancer Risk Estimation

In order to estimate potential non-carcinogenic risk, the estimated ADDs calculated for each exposure route considered and each COPC are compared to RfDs. The following formula is used to estimate the potential non-carcinogenic risk for each COPC:

$$ADD \div RfD = HQ$$

where:

ADD = average daily dose of COPC (mg/Kg-day)
RfD = reference dose (mg/K-day), and
HQ = hazard quotient (unitless).

As described in the previous section, the chronic RfD for a given COPC is an estimate of a lifetime daily exposure level for the human population, including sensitive subpopulations, which is likely to be without an appreciable risk of deleterious effects. The potential for non-cancer health effects is evaluated by comparing a potential exposure level over a specified time period with an RfD that has been derived by EPA for a similar exposure period under similar circumstances. This ratio of potential exposure to toxicity is the hazard quotient (HQ).

When the HQ for a given constituent and pathway does not exceed 1, the RfD has not been exceeded, and no adverse non-cancer health effects are expected to occur as a result of potential exposure to that constituent via that pathway. The HQs for each constituent are summed to yield the Hazard Index (HI) for that pathway. A Total HI is then calculated for each exposure medium by summing the pathway-specific HIs. A Total HI that does not exceed 1 indicates that no adverse non-carcinogenic health effects are expected to occur as a result of that receptor's potential exposure to the environmental media evaluated. This approach assumes that the critical effects of multiple chemicals are additive. This is appropriate only for compounds that induce the same effect on the same target organ by the same mechanism of action and for most chemicals, the critical effect differs. This conservative approach significantly overestimates the actual potential for adverse health impacts if different COPCs are affecting different target organs.

Cancer Risk Estimation

The purpose of carcinogenic risk characterization is to estimate the potential likelihood, over and above the background cancer rate, that a receptor will develop cancer in his or her lifetime as a result of potential Site-related exposures to COPCs in various environmental media. This likelihood is a function of the potential dose of a constituent and the CSF for that constituent. To estimate the potential cancer risk associated with exposure to a chemical, the CSF for the chemical is multiplied by the ADD calculated for that chemical through each exposure pathway. CSFs for carcinogenic oral and inhalation effects are discussed in Section 5.0. ADDs associated with each of the exposure pathways (Section 4.0) are multiplied by the chemical's CSF:

$$CSF \times ADD = CR$$

where:

CSF	=	cancer slope factor [1/(mg/Kg-day)]
ADD	=	calculated potential average daily dose of COPC (mg/Kg-day), and
CR	=	cancer risk (no units).

For potential excess lifetime cancer risks, USEPA's acceptable risk range is between one-in-ten-thousand and one-in-a-million (1×10^{-4} to 1×10^{-6}). Cancer risks less than or equal to 1×10^{-6} represent the threshold used by NJDEP to assess potential cancer risks. The risk characterization presented below will assess the cancer risk results against both of these risk thresholds.

For exposures to multiple carcinogens, USEPA (1989) has required the upper limits of cancer risks for all COPCs in all exposure pathways for a given receptor be summed to derive a total cancer risk:

$$\text{Total cancer risk} = \Sigma \text{ cancer risk for each COPC}$$

USEPA recognizes that it is not technically appropriate to sum UCLs of the risk to produce a total probability, but still requires that this approach be used.

6.2 Potential Post-Remediation/Redevelopment Risks

This section summarizes the potential post-remediation/redevelopment risks for all COPCs, except for lead. The lead assessment is presented in Section 6.3.

6.2.1 Potential Groundwater Exposures by Pipeline Inspection/Repair Workers

Table 10 summarizes the cancer and non-cancer risk results from the evaluation of incidental groundwater contact by Pipeline Inspection/Repair Workers. Four COPCs (arsenic, benzo(a)anthracene, benzene, and vinyl chloride) were detected in the groundwater samples and were evaluated for this scenario. The cumulative risks across all chemicals and exposure pathways are summarized in the table below.

	CTE Case	RME Case
Cancer Risk	7.5E-08	1.2E-07
Non-Cancer Risk	1.2E-03	1.2E-03

For both the CTE and RME Cases, the potential cancer risks associated with groundwater exposure were below 1 x 10^{-6} for all individual routes and for the combined routes (ingestion and dermal). Similarly, for both the CTE and RME Cases, the potential non-cancer risks associated with groundwater exposure were below the threshold hazard index of 1 for all routes, combined routes and cumulative non-cancer risks for all COPCs.

Based on this assessment the chemicals present in the groundwater do not pose a significant cancer or non-cancer risk to the evaluated receptors under their assumed exposure conditions.

6.2.2 Potential Soil Exposures by Pipeline Inspection/Repair Workers

Table 11 summarizes the cancer and non-cancer risk results from the evaluation of incidental soil contact by Pipeline Inspection/Repair Workers. The cumulative risks across all chemicals and exposure pathways are summarized in the table below.

	CTE Case	RME Case
Cancer Risk	4.5E-07	7.5E-07
Non-Cancer Risk	6.6E-02	6.6E-02

For both the CTE and RME Cases, the potential cancer risks associated with soil exposure were below 1 x 10^{-6} for all routes and for the combined routes (ingestion, dermal and inhalation). Similarly, for both the CTE and RME Cases, the potential non-cancer risks associated with soil exposure were below the threshold hazard index of 1 for all routes, combined routes and cumulative non-cancer risks for all COPCs.

6.3 Risk Characterization of Lead in Soils

After the proposed remediation/redevelopment of the BB&D Site, an average residual lead concentration of 1,503 mg/Kg (Table 7b) will remain on site in subsurface soil, beneath the engineered cap. Typically, EPA's Adult Lead Model (ALM) is used to evaluate risks from exposure to residual lead (USEPA, 2003b). The ALM is recommended for repeated intermittent or continuous exposures over extended periods of time. The ALM is not ideally suited for application to situations like the Gas Pipeline Utility Worker whose exposure is very infrequent (one day per year). The pharmacokinetic relationship that the model is based on (predicting steady-state blood-lead concentrations) doesn't work under very infrequent intermittent exposures. That is because, at very infrequent exposure frequencies, blood lead concentrations will not approach a steady state concentration relative to the exposure source.

As discussed in the guidance, the shortest appropriate exposure duration is three months (90 days). A minimum frequency of exposure of 1 day per week is also recommended. Clearly, the one day per year exposure scenario at the BB&D Site does not meet these criteria. However, lacking any other tool to evaluate the risks associated with residual lead at the BB&D Site, the ALM can provide substantiation that the residual soil lead concentrations at the BB&D Site following remediation/redevelopment will not present a significant risk to human health.

If one runs the ALM model using all default values and an exposure frequency of 52 days/year (the minimum value recommended as valid by USEPA), the resulting range of lead remediation goals is 2,800 to 4,100 mg/Kg, corresponding to geometric standard deviations of 2.1 and 1.8, respectively. While the default ALM input for daily soil ingestion is a rate of 100 mg/day, EPA's default value for utility and construction workers is 330 mg/day. Making the adjustment for the 330 mg/Kg vs. 100 mg/Kg in the ALM generates a range of lead remediation goals of approximately 850 to 1,242 mg/kg. A value of 1,250 mg/Kg of lead has been used at other Superfund sites in EPA Region II (e.g. Cornell Dubilier Electronics Site; USEPA 2002a), clearly derived using the ALM with similar default assumptions.

If one uses this value of 1,250 mg/kg as a benchmark, the post-remediation/redevelopment level of 1,500 mg/Kg for the BB&D site compares very favorably, in light of the fact that the anticipated BB&D exposure frequency is one day per year compared with the 52 days per year basis for the 1250 mg/Kg value. Based on this analysis and comparison with the ALM model, it is concluded that the residual lead concentrations at the BB&D Site following remediation/redevelopment (approximately 1,500 mg/Kg as a mean lead soil concentration) will not present a significant risk to human health.

7.0 UNCERTAINTY ANALYSIS

The five major components of a risk assessment are: the conceptual site model, data analysis, exposure assessment, toxicity assessment, and risk characterization. Within any of the five steps of the risk assessment process, assumptions must be made due to a lack of absolute scientific knowledge. Some of the assumptions are supported by considerable scientific evidence, while others have less support. Every assumption introduces some degree of uncertainty into the risk assessment process. Conservative assumptions are made throughout the risk assessment to ensure that public health is protected. Therefore, when all of the assumptions are combined, it is much more likely that actual risks, if any, are overestimated rather than underestimated.

The assumptions that introduce the greatest amount of uncertainty in this risk assessment are discussed in this section. They are discussed in general terms because, for most of the assumptions, there is not enough information to assign a numerical value that can be factored into the calculation of risk.

7.1 Uncertainty in the Conceptual Site Model

The primary uncertainty in the CSM is the uncertainty associated with correctly identifying complete exposure pathways. If an exposure pathway is identified as complete when, in fact, it is not complete, risk will be overestimated for that receptor. Likewise, if an exposure pathway is identified as incomplete when it is complete, risk will be underestimated for that receptor.

The Site CSM was developed based on the current, best understanding potential post-remediation conditions. The CSM is conservative since it assumes unprotected potential contact with subsurface soils during repair activities.

7.2 Uncertainty in the Data Analysis

The two principal areas of uncertainty relative to the data analysis were the chemical screening and the calculation of EPCs.

7.2.1 Chemical Screening

The initial screening of chemicals for use as COPCs was performed using the average chemical concentrations. This was done chiefly because of the large number of analytical results available for this Site. As part of the uncertainty assessment an evaluation was performed to determine whether the use of the maximum value would result in a larger number of COPCs than evaluated in Section 6 of the FRA.

Groundwater Screening

The chemical screening for groundwater (Table 5) included the comparisons using both the mean and maximum observed concentrations. Table 12 identifies those chemicals whose maximum values exceeded screening criteria, but had been screened out using the mean values. The eight chemicals included the following: Aluminum, Antimony, Lead, Chrysene, 1,1,2-Trichloroethane, Methylene Chloride, Tetrachloroethene, and Trichloroethene. A supplemental screen using the EPA Region III Risk-Based Concentrations (RBCs) and EPA Region IV Preliminary Remedial Goals (PRGs) were performed as part of this uncertainty assessment to further assess these results. The RBCs and PRGs used for groundwater were those developed for tap water, and they correspond to a hazard quotient of 1 or an incremental lifetime cancer risk of 1 x 10^{-6} (USEPA, 2004c, 2005). As a result, the RBCs and PRGs represent conservative screens for the incidental contact with groundwater. The following is a summary of this additional screening assessment:

- *Aluminum*: Aluminum was detected in 14 of the 16 groundwater samples. The maximum observed concentration of aluminum (1,060 µg/L) was less than the RBC or PRG values and therefore aluminum would not pass the screen if these alternate risk-based values were used.

- *Antimony*: Antimony was detected in 4 of the 16 groundwater samples. The maximum result (62.2 µg/L) was observed in one well (BBD-C2). Review of all of the antimony results showed that the next highest positive result (8.6 µg/L; well LBMW-3), which was less than the New Jersey Class IIA values used in the original screen, as well as the RBC and PRG values used in the supplemental screen.

- *Lead*: Lead was detected in 5 of the 16 groundwater samples. RBC and PRG values are not available for assessing this chemical. Review of all of the lead results showed that the next highest positive result (6.4 µg/L; well BBD-C1) was less than the New Jersey Class IIA values used in the original screen.

- *Chrysene, 1,1,2-Trichloroethane, Methylene Chloride, Tetrachloroethene, and Trichloroethene*: All five of these chemicals were detected in only 1 of the 16 groundwater samples. Chrysene was detected in the sample from MW-A, and the remaining four chemicals were all detected in one well sample (FCA-MW-1). The single observed concentrations were all greater than the RBC or PRG values.

The single exceedances of the screening criteria for seven of these chemicals (Antimony, Lead, Chrysene, 1,1,2-Trichloroethane, Methylene Chloride, Tetrachloroethene, and Trichloroethene) does not warrant their further consideration in the FRA. As noted above, based on the concentrations measured in groundwater, aluminum would also be excluded as a potential COPC.

Soil Screening

As with the groundwater screening, the chemical screening for soils (Table 6) included the comparisons using both the mean and maximum observed concentrations. Table 13 identifies those chemicals whose maximum values exceeded screening criteria, but had been screened out using the mean values. A total of thirteen chemicals fell into this group, which included six metals (Antimony, Beryllium, Cadmium, Copper, Thallium, and Zinc), three pesticides (4,4'-DDD, 4,4'-DDE, and heptachlor), and four volatile organics (Ethylbenzene, Tetrachloroethene, Toluene, and Trichloroethene). A supplemental screen using the industrial soil RBCs and PRGs was performed and the following is a summary of this additional assessment:

- *Antimony, Beryllium, Cadmium, Copper, Thallium, and Zinc*: The detection frequencies for these six metals were 63/77, 74/79, 65/78, 79/79, 12/72, and 79/79, respectively. None of the maximum observed values were greater than either the RBC or PRG values, and therefore these metals would not be retained as COPCs.

- *4,4'-DDD, 4,4'-DDE, and Heptachlor*: The detection frequencies for these three pesticides were 68/128, 101/133, and 19/99, respectively. As described below, the maximum observed values were greater than either the RBC or PRG values.

  For 4,4'-DDD, only two of the 128 samples were greater than the RBC. Both of these samples (STA-4 and STA-5; located in the former Storage Tank Area) were subsurface soils (3.5 to 4 feet), where incidental contact is unlikely. For 4,4'-DDE, only three of the 133 samples were greater than the RBC. Two of these samples (STA-4 and STA-5; located in the former Storage Tank Area) were subsurface soils (3.5 to 4 feet) - where incidental contact is unlikely - and the other sample (BLDG1-3A) was a shallow (0 to 2 feet). The sporadic occurrences of DDD and DDE above the supplemental screening limits, but these results do not suggest that these compounds should be considered to be COPCs.

  For heptachlor, only one 99 samples was greater than the RBC. This sample (DC-4) was a surface sample (0 to 0.5 ft) from the Yard Area. The next positive result was 0.74, well below RBC and PRG values, and slightly above the New Jersey Non-Residential Direct Contact concentration (0.65 mg/Kg). The single positive result above the supplemental screening limits does not suggest that heptachlor should be considered to be a COPC.

- *Ethylbenzene, Tetrachloroethene, Toluene, and Trichloroethene*: The detection frequencies for these four volatile organics were 79/124, 14/106, 106/132, and 19/110, respectfully. None of the maximum observed values were greater than the RBC values, but all were greater than the PRG values. Therefore, none of the VOCs would likely contribute significantly to the cumulative risks calculated using the COPCs.

7.2.2 Calculation of EPCs

Sampling (especially in multiple sampling events) is typically not random, but is designed to locate the highest constituent concentrations. Combining data biased in this manner with EPC calculation procedures that do not account for that bias, as is the case when using the 95UCL, will result in EPCs that are biased high and will substantially overestimate the actual concentration to which receptors may be exposed. For this reason, the average concentrations are more likely to be representative of actual exposure potential than the 95UCL estimates of the means used in this FRA.

As part of this uncertainty assessment, the potential impact of using the average concentration to assess the potential risks to Inspection/Repair Workers was evaluated. Table 14 summarizes the calculated cancer and non-cancer risks for this receptor for the individual COPCs, and the table below summarizes the incremental decrease (calculated as a percent difference) when the mean values were used in lieu of the 95UCL values as the EPCs.

Endpoint	Combined Soil Routes Across COPCs			%Diff
	Case	95 UCL	Mean	
Potential Cancer Risks	CTE	4.5E-07	1.7E-07	-62%
	RME	7.5E-07	2.9E-07	-62%
Potential Non-Cancer Risks	CTE	0.066	0.030	-54%
	RME	0.066	0.030	-54%

Use of the average soil concentration, which is not unreasonable based on the large number of samples and spatial coverage of the samples across the property, results in all calculated cumulative cancer and non-cancer risks below the risk thresholds.

7.3 Uncertainties in Assessing Potential Exposure

During the exposure assessment, average daily doses of COPCs to which receptors are potentially exposed are estimated. This process involves assumptions about how often exposure occurs. Such assumptions include location, accessibility, and use of an area. With this in mind, the receptor, or person who may potentially be exposed, and the location of exposure, were both defined for this FRA. The locations where certain activities were assumed to take place have been intentionally selected to be consistent with the use of the Site. However, as discussed earlier, the exposures assume that an appropriate health and safety plan and deed restriction will not be in-place during any invasive activities, which is highly unlikely. Consequently, the calculated risks are more conservative than may occur during such activities.

7.4 Uncertainty of Toxicity Values

Dose-response values are usually based on limited toxicological data. For this reason, a margin of safety is built into estimates of both cancer and non-cancer risk, and actual risks are lower than those estimated. The two major areas of uncertainty introduced in the dose-response assessment are: (1) animal to human extrapolation; and (2) high to low dose extrapolation. These are discussed below.

Human dose-response values are often extrapolated, or estimated, using the results of animal studies. Extrapolation from animals to humans introduces a great deal of uncertainty in the risk assessment because in most instances, it is not known how differently a human may react to the constituent compared to the animal species used to test the constituent. The procedures used to extrapolate from animals to humans involve conservative assumptions and incorporate several uncertainty factors that overestimate the adverse effects associated with a specific dose. As a result, overestimation of the potential for adverse effects to humans is more likely than underestimation.

Predicting potential health effects from the exposure to media on-Site requires the use of models to extrapolate the observed health effects from the high doses used in laboratory studies to the anticipated human health effects from low doses experienced in the environment. The models contain conservative assumptions to account for the large degree of uncertainty associated with this extrapolation (especially for potential carcinogens) and therefore, tend to be more likely to overestimate than underestimate the risks.

8.0 FOCUSED HUMAN HEALTH RISK ASSESSMENT CONCLUSIONS

The FRA for the Bayonne Barrel and Drum Site provides a site-specific human health risk assessment (post-remediation/redevelopment) to support a proposal for a Risk-Based PCB disposal approval under 40 CFR 761.61 (c). Nine chemicals in soils and four chemicals in the groundwater were evaluated as COPCs. The potential cancer and non-cancer risks are presented in Tables 10 and 11.

Based on this assessment, the chemicals remaining in the groundwater and soil will not pose a significant cancer or non-cancer risk to the evaluated receptors under the assumed exposure conditions associated with the proposed remediation/redevelopment plan as presented in the RASR. Accordingly, this assessment demonstrates that the selected remediation/redevelopment plan is protective and does not present unreasonable risk to human health and safety. Furthermore, the proposed remediation/redevelopment plan conforms to N.J.S.A.58:10B-12(d)(1) and (2). (2005) for achieving risk-based levels of 1×10^{-6} excess cancer risk and a non-carcinogen hazard index of 1.

8.1 Summary of Groundwater Contact Risk Results

For both the CTE and RME Cases, the potential cumulative cancer risks a across all chemicals and exposure routes (ingestion and dermal) for groundwater exposure were below 1×10^{-6} (RME Case = 1.2×10^{-7}; CTE Case = 7.5×10^{-8}). Similarly, for both the CTE and RME Cases, the potential cumulative non-cancer risks across all chemicals and exposure routes (ingestion and dermal) for groundwater exposure were below the threshold hazard index of 1.

Based on this assessment the chemicals present in the groundwater do not pose a significant cancer or non-cancer risk to the evaluated receptors under their assumed exposure conditions.

8.2 Summary of Soil Contact Risk Results

For both the CTE and RME Cases, the potential cumulative cancer risks across all chemicals and exposure routes (ingestion, dermal and inhalation) for soil were below 1×10^{-6} (RME Case = 7.5×10^{-7}; CTE Case = 4.5×10^{-7}). Similarly, for both the CTE and RME Cases, the potential cumulative non-cancer risks across all chemicals and exposure routes (ingestion, dermal and inhalation) for soil exposure were below the threshold hazard index of 1.

9.0 REFERENCES

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Table 1. Bayonne Barrel and Drum
Screening Assessment of Potential Exposure Pathways For Soils Following Remediation

Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age Group	Exposure Route	Rationale for Selection or Exclusion of Exposure Pathway
Soil	Surface Soil	Surface Soil	Resident	Adult or child	Ingestion	Excluded; Clean cap material will be used for remediation/redevelopment.
	Surface Soil	Surface Soil	Resident	Adult or child	Dermal	Excluded; Clean cap material will be used for remediation/redevelopment.
	Surface Soil	Surface Soil	Site Employee	Adult or child	Ingestion	Excluded; Clean cap material will be used for remediation/redevelopment.
	Surface Soil	Surface Soil	Site Employee	Adult or child	Dermal	Excluded; Clean cap material will be used for remediation/redevelopment.
	Surface Soil	Surface Soil	Site Visitor	Adult or child	Ingestion	Excluded; Clean cap material will be used for remediation/redevelopment.
	Surface Soil	Surface Soil	Site Visitor	Adult or child	Dermal	Excluded; Clean cap material will be used for remediation/redevelopment.
	Combined Surface and Subsurface Soil As Particulates	Air	Inspector/Repair Worker	Adult	Inhalation	Include for quantitative assessment
	Combined Surface and Subsurface Soil	Combined Surface and Subsurface Soil	Inspector/Repair Worker	Adult	Ingestion	Include for quantitative assessment
			Inspector/Repair Worker	Adult	Dermal	Include for quantitative assessment

Notes:
Surface soils represent the 0 to 6-in interval, while the combined surface and subsurface soil were those from all remaining depths.

Table 2. Bayonne Barrel and Drum
Screening Assessment of Potential Exposure Pathways For Groundwater Following Remediation

Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age Group	Exposure Route	Rationale for Selection or Exclusion of Exposure Pathway
Groundwater	Groundwater	Groundwater	Resident	Adult and Child	Ingestion	Excluded; Potable water supply provided by municipality. Future development of groundwater for potable use in area unlikely.
Groundwater	Groundwater	Groundwater	Resident	Adult and Child	Dermal	
Groundwater	Vapor	Air	Resident	Adult and Child	Inhalation	
Groundwater	Groundwater	Groundwater	Site Employee	Adult and Child	Ingestion	Excluded; Potable water supply provided by municipality. Future development of groundwater for potable use in area unlikely.
Groundwater	Groundwater	Groundwater	Site Employee	Adult and Child	Dermal	
Groundwater	Vapor	Air	Site Employee	Adult and Child	Inhalation	
Groundwater	Groundwater	Groundwater	Site Visitor	Adult and Child	Ingestion	Excluded; Potable water supply provided by municipality. Future development of groundwater for potable use in area unlikely.
Groundwater	Groundwater	Groundwater	Site Visitor	Adult and Child	Dermal	
Groundwater	Vapor	Air	Site Visitor	Adult and Child	Inhalation	Excluded; Rapid dilution of any emitted chemicals in overlying air.
Groundwater	Groundwater	Groundwater	Inspector/Repair Worker	Adult	Dermal	Include for quantitative assessment
Groundwater	Groundwater	Groundwater	Inspector/Repair Worker	Adult	Ingestion	Include for quantitative assessment
Groundwater	Vapor	Air	Inspector/Repair Worker	Adult	Inhalation	Excluded; Minor pathway. Exposure more representative based on dermal route.

Table 3. Bayonne Barrel & Drum - Exposure Assumptions for Groundwater-Based Pathways for the Inspection/Repair Workers

Exposure Route	Receptor Group	Exposure Media	Parameter Definition	Input Values		Units	Comments
				CTE Case	RME Case		
Dermal	Adult	Groundwater	Chemical Concentration	Chem Specific	Chem Specific	mg/L	See Table 7a
			Exposure Frequency	4	4	days/year	Assumes a 4-day repair event (pers comm; Attachment 1).
			Exposure Duration - Cancer	1	1.7	years	Assumes the 4-day event occurs every 15 years (pers comm; Attachment 1) which is then combined with CTE and RME job tenures from USEPA (1997, 2004b) of 10 and 25 years to derive 1 and 1.7 CTE and RME, respectively.
			Exposure Duration - Noncancer	1	1	years	Assumes a single 4-day event averaged over 1 year.
			Exposure Time	8	8	hours/day	Assumes an 8-hour workday
			Fraction from Site	0.25	0.25	unitless	Professional judgment
			Conversion Factor	1.00E-03	1.00E-03	liter/cm^3	Calculated
			Body Weight	71.8	71.8	kg	USEPA (1997)
			Averaging Time - Cancer	27,375	27,375	days	Calculated
			Averaging Time - Noncancer	365	365	days	Calculated
			Skin Surface Area	2,733	2,733	cm^2/day	RAGS Part E, Exhibit C-1 (USEPA, 2004)
			Permeability Coefficient	Chem Specific	Chem Specific	cm/hr	See Table 8 - based on RAGS Part E, (USEPA, 2004).
Incidental Ingestion	Adult	Groundwater	Concentration in Water	Chem Specific	Chem Specific	mg/L	See Table 7a
			Ingestion Rate	25	25	mL/day	Professional judgment
			Exposure Frequency	4	4	days/year	Assumes a 4-day repair event (pers comm; Attachment 1).
			Oral Absorption Factor	Chem Specific	Chem Specific	(unitless)	See Table 8
			Exposure Duration - Cancer	1	1.7	years	Assumes the 4-day event occurs every 15 years (pers comm; Attachment 1) which is then combined with CTE and RME job tenures from USEPA (1997, 2004b) of 10 and 25 years to derive 1 and 1.7 CTE and RME, respectively.
			Exposure Duration - Noncancer	1	1	years	Assumes a single 4-day event averaged over 1 year.
			Fraction from Site	0.25	0.25	unitless	Professional judgment
			Oral Absorption Factor	Chem Specific	Chem Specific	(unitless)	See Table 8
			Conversion Factor	0.001	0.001	L/mL	Calculated
			Body Weight	71.8	71.8	kg	USEPA (1997)
			Averaging Time - Cancer	27375	27375	days	Calculated
			Averaging Time - Noncancer	365	621	days	Calculated

Table 4. Bayonne Barrel & Drum - Exposure Assumptions for Soil-Based Pathways for the Inspection/Repair Workers

Receptor	Area	Exposure Route	Parameter Definition	Input Values		Units	Comment/Data Source
				CTE Case	RME Case		
Adult	Surface and Subsurface Soil	Dermal	Concentration in Soil	Chem Specific	Chem Specific	mg/kg	See Table 7b
			Dermal Adherence Factor	0.3	0.3	mg/cm^2	SSL Guidance (USEPA, 2001)
			Skin Surface Area	3300	3300	cm^2/day	SSL Guidance (USEPA, 2001)
			Dermal Absorption Factor	Chem Specific	Chem Specific	unitless	See Table 8 - based on RAGS Part E, Exhibit 4-1 (USEPA, 2004).
			Exposure Frequency	4	4	days/year	Assumes a 4-day repair event (pers comm; Attachment 1).
			Exposure Duration - Cancer	1	1.7	years	Assumes the 4-day event occurs every 15 years (pers comm; Attachment 1) which is then combined with CTE and RME job tenures from USEPA (1997, 2004b) of 10 and 25 years to derive 1 and 1.7 CTE and RME, respectively.
			Exposure Duration - Noncancer	1	1	years	Assumes a single 4-day event averaged over 1 year.
			Fraction From Site	0.25	0.25	unitless	Professional judgment
			Conversion Factor	1.0E-06	1.0E-06	kg/mg	Calculated
			Body Weight	71.8	71.8	kg	USEPA (1997)
			Averaging Time - Cancer	27375	27375	days	Calculated
			Averaging Time - Noncancer	365	365	days	Calculated
Adult	Surface and Subsurface Soil	Incidental Ingestion	Concentration in Soil	Chem Specific	Chem Specific	mg/kg	See Table 7b
			Ingestion Rate	330	330	mg/day	SSL Guidance, Exhibit 1-2 (USEPA, 2001)
			Oral Absorption Factor	Chem Specific	Chem Specific	unitless	See Table 8 - based on RAGS Part E, Exhibit 4-1 (USEPA, 2004)
			Exposure Frequency	4	4	days/year	Assumes a 4-day repair event (pers comm; Attachment 1).
			Exposure Duration - Cancer	1	1.7	years	Assumes the 4-day event occurs every 15 years (pers comm; Attachment 1) which is then combined with CTE and RME job tenures from USEPA (1997, 2004b) of 10 and 25 years to derive 1 and 1.7 CTE and RME, respectively.
			Exposure Duration - Noncancer	1	1	years	Assumes a single 4-day event averaged over 1 year.
			Fraction From Site	0.25	0.25	unitless	Professional judgment
			Conversion Factor	1.0E-06	1.0E-06	kg/µg	Calculated
			Body Weight	71.8	71.8	kg	USEPA (1997)
			Averaging Time - Cancer	27375	27375	days	Calculated
			Averaging Time - Noncancer	365	365	days	Calculated

Table 4. Bayonne Barrel & Drum - Exposure Assumptions for Soil-Based Pathways for the Inspection/Repair Workers

Receptor	Area	Exposure Route	Parameter Definition	Input Values		Units	Comment/Data Source
				CTE Case	RME Case		
Adult	Surface and Subsurface Soil	Particulate Inhalation	Concentration in Soil	Chem Specific	Chem Specific	mg/kg	See Table 7b
			Respirable Particulate Matter	150	150	µg/m3	Value is the maximum allowable 24-hour PM_{10} concentration in NJ.
			Exposure Time	8	8	hours/day	An 8-hour workday
			Oral Absorption Factor	1	1	unitless	Conservative assumption
			Inhalation Rate	1.5	1.5	m^3/hour	Outdoor workers, moderate activity (USEPA, 1997)
			Exposure Frequency	4	4	days/year	Assumes a 4-day repair event (pers comm; Attachment 1).
			Exposure Duration - Cancer	1	1.7	years	Assumes the 4-day event occurs every 15 years (pers comm; Attachment 1) which is then combined with CTE and RME job tenures from USEPA (1997, 2004b) of 10 and 25 years to derive 1 and 1.7 CTE and RME, respectively.
			Exposure Duration - Noncancer	1	1	years	Assumes a single 4-day event averaged over 1 year.
			Fraction From Site	0.25	0.25	unitless	Professional judgment
			Conversion Factor	1.0E-09	1.0E-09	kg/µg	Calculated
			Body Weight	71.8	71.8	kg	USEPA (1997)
			Averaging Time - Cancer	27375	27375	days	Calculated
			Averaging Time - Noncancer	365	365	days	Calculated

Table 5. Bayonne Barrel & Drum - Screening of Groundwater Results

Chem Class	Media	Parameter	Detect Freq	Avg Conc	Max Pos Conc	Class A Carc?	NJ GW Class IIA Value	Units	Freq>5%	Max > GW Value	Avg > GW Value	Retain as COC?
Metals	Groundwater	Aluminum	14/16	1.71E+02	1.06E+03	No	2.00E+02	µg/L	Yes	Yes	No	No
Metals	Groundwater	Antimony	4/16	7.34E+00	6.22E+01	No	2.00E+01	µg/L	Yes	Yes	No	No
Metals	Groundwater	Arsenic	10/16	8.88E+00	4.49E+01	Yes	8.00E+00	µg/L	Yes	Yes	Yes	Yes
Metals	Groundwater	Barium	16/16	3.35E+02	1.16E+03	No	2.00E+03	µg/L	Yes	No	No	No
Metals	Groundwater	Cadmium	1/16	2.88E-01	1.60E+00	No	4.00E+00	µg/L	Yes	No	No	No
Metals	Groundwater	Calcium	16/16	1.48E+05	3.23E+05	No		µg/L	Yes	No	No	No
Metals	Groundwater	Chromium	7/16	2.39E+00	8.40E+00	No	1.00E+02	µg/L	Yes	No	No	No
Metals	Groundwater	Cobalt	6/16	3.11E+00	9.00E+00	No		µg/L	Yes	No	No	No
Metals	Groundwater	Copper	2/16	4.33E+00	3.41E+01	No	1.00E+03	µg/L	Yes	No	No	No
Metals	Groundwater	Iron	16/16	1.67E+04	4.34E+04	No	3.00E+02	µg/L	Yes	Yes	Yes	No
Metals	Groundwater	Lead	5/16	4.90E+00	4.14E+01	No	1.00E+01	µg/L	Yes	Yes	No	No
Metals	Groundwater	Magnesium	16/16	2.58E+04	9.37E+04	No		µg/L	Yes	No	No	No
Metals	Groundwater	Manganese	16/16	2.09E+03	1.16E+04	No	5.00E+01	µg/L	Yes	Yes	Yes	No
Metals	Groundwater	Mercury	1/16	8.88E-02	8.70E-01	No	2.00E+00	µg/L	Yes	No	No	No
Metals	Groundwater	Nickel	16/16	1.60E+01	9.02E+01	No	1.00E+02	µg/L	Yes	No	No	No
Metals	Groundwater	Selenium	2/16	2.39E+00	4.60E+00	No	5.00E+01	µg/L	Yes	No	No	No
Metals	Groundwater	Sodium	16/16	1.72E+05	1.06E+06	No	5.00E+04	µg/L	Yes	Yes	Yes	No
Metals	Groundwater	Vanadium	16/16	4.01E+00	9.70E+00	No		µg/L	Yes	No	No	No
Metals	Groundwater	Zinc	11/16	3.47E+02	3.55E+03	No	5.00E+03	µg/L	Yes	No	No	No
SVOC TICs	Groundwater	Total SVOC TICs	13/16	3.81E+03	5.41E+04	No	5.00E+02	µg/L	Yes	Yes	Yes	No
SVOCs	Groundwater	1,2,4-Trichlorobenzene	2/16	1.60E+00	5.10E+00	No		µg/L	Yes	No	No	No
SVOCs	Groundwater	1,2-Dichlorobenzene	1/16	1.61E+00	1.90E+00	No		µg/L	Yes	No	No	No
SVOCs	Groundwater	1,3-Dichlorobenzene	1/16	1.34E+00	2.20E+00	No		µg/L	Yes	No	No	No
SVOCs	Groundwater	1,4-Dichlorobenzene	3/16	2.14E+00	3.10E+00	No		µg/L	Yes	No	No	No
SVOCs	Groundwater	2,4-Dimethylphenol	4/16	1.38E+03	2.20E+04	No		µg/L	Yes	No	No	No
SVOCs	Groundwater	2-Methylnaphthalene	5/16	8.42E+01	6.40E+02	No		µg/L	Yes	No	No	No
SVOCs	Groundwater	2-Methylphenol	1/16	3.30E+00	6.40E+00	No		µg/L	Yes	No	No	No
SVOCs	Groundwater	4-Methylphenol	3/16	1.31E+03	2.10E+04	No		µg/L	Yes	No	No	No
SVOCs	Groundwater	Acenaphthene	10/16	1.06E+01	6.80E+01	No	4.00E+02	µg/L	Yes	No	No	No
SVOCs	Groundwater	Anthracene	7/16	3.91E+00	2.10E+01	No	2.00E+03	µg/L	Yes	No	No	No
SVOCs	Groundwater	Benzo(a)anthracene	1/16	1.76E+00	2.70E+01	No	5.00E-02	µg/L	Yes	Yes	Yes	Yes
SVOCs	Groundwater	bis(2-Ethylhexyl)phthalate	4/16	3.22E+00	1.20E+00	No	3.00E+01	µg/L	Yes	No	No	No
SVOCs	Groundwater	Carbazole	4/16	1.87E+00	2.30E+01	No		µg/L	Yes	No	No	No
SVOCs	Groundwater	Chrysene	1/16	1.57E+00	2.40E+01	No	5.00E+00	µg/L	Yes	Yes	No	No
SVOCs	Groundwater	Dibenzofuran	5/16	3.06E+00	1.30E+01	No	1.00E+02	µg/L	Yes	No	No	No
SVOCs	Groundwater	Diethylphthalate	7/16	1.53E+00	3.40E+00	No	5.00E+03	µg/L	Yes	No	No	No
SVOCs	Groundwater	Di-n-butylphthalate	6/16	2.03E+00	1.90E+00	No	9.00E+02	µg/L	Yes	No	No	No
SVOCs	Groundwater	Di-n-octylphthalate	1/16	2.14E+00	9.00E-01	No	1.00E+02	µg/L	Yes	No	No	No
SVOCs	Groundwater	Fluoranthene	6/16	2.49E+00	2.20E+01	No	3.00E+02	µg/L	Yes	No	No	No
SVOCs	Groundwater	Fluorene	8/16	9.78E+00	7.40E+01	No	3.00E+02	µg/L	Yes	No	No	No
SVOCs	Groundwater	Naphthalene	10/16	9.36E+01	6.10E+02	No		µg/L	Yes	No	No	No
SVOCs	Groundwater	N-Nitrosodiphenylamine	1/16	9.97E-01	6.00E-01	No	2.00E+01	µg/L	Yes	No	No	No

Table 5. Bayonne Barrel & Drum - Screening of Groundwater Results

Chem Class	Media	Parameter	Detect Freq	Avg Conc	Max Pos Conc	Class A Carc?	NJ GW Class IIA Value	Units	Freq>5%	Max > GW Value	Avg > GW Value	Retain as COC?
SVOCs	Groundwater	Phenanthrene	7/16	1.47E+01	1.00E+02	No	1.00E+02	µg/L	Yes	No	No	No
SVOCs	Groundwater	Phenol	2/16	2.29E+01	3.50E+02	No		µg/L	Yes	No	No	No
SVOCs	Groundwater	Potassium	16/16	1.74E+04	4.19E+04	No		µg/L	Yes	No	No	No
SVOCs	Groundwater	Pyrene	5/16	2.93E+00	2.50E+01	No	2.00E+02	µg/L	Yes	No	No	No
VOC TICs	Groundwater	Total VOC TICs	13/16	4.87E+02	2.45E+03	No	5.00E+02	µg/L	Yes	Yes	No	No
VOCs	Groundwater	1,1,1-Trichloroethane	1/16	2.13E-01	7.00E-01	No	3.00E+01	µg/L	Yes	No	No	No
VOCs	Groundwater	1,1,2-Trichloroethane	1/16	5.75E-01	6.50E+00	No	3.00E+00	µg/L	Yes	Yes	No	No
VOCs	Groundwater	1,1-Dichloroethane	2/16	1.18E+00	9.60E+00	No	5.00E+01	µg/L	Yes	No	No	No
VOCs	Groundwater	2-Butanone	1/16	2.76E+00	3.60E+01	No		µg/L	Yes	No	No	No
VOCs	Groundwater	4-Methyl-2-Pentanone	2/16	1.83E+01	1.70E+02	No	4.00E+02	µg/L	Yes	No	No	No
VOCs	Groundwater	Acetone	8/16	1.31E+01	6.80E+01	No	7.00E+02	µg/L	Yes	No	No	No
VOCs	Groundwater	Benzene	7/16	4.61E+01	3.90E+02	Yes	1.00E+00	µg/L	Yes	Yes	Yes	Yes
VOCs	Groundwater	Carbon Disulfide	12/16	2.00E+00	9.60E+00	No	8.00E+02	µg/L	Yes	No	No	No
VOCs	Groundwater	Chlorobenzene	7/16	4.26E+00	2.80E+01	No	5.00E+01	µg/L	Yes	No	No	No
VOCs	Groundwater	Chloroethane	2/16	6.19E-01	3.90E+00	No	1.00E+02	µg/L	Yes	No	No	No
VOCs	Groundwater	cis-1,2-Dichloroethene	2/16	1.34E+00	1.60E+01	No	7.00E+01	µg/L	Yes	No	No	No
VOCs	Groundwater	Ethylbenzene	6/16	2.32E+01	2.70E+02	No	7.00E+02	µg/L	Yes	No	No	No
VOCs	Groundwater	Methylene Chloride	1/16	9.00E-01	6.30E+00	No	3.00E+00	µg/L	Yes	Yes	No	No
VOCs	Groundwater	Tetrachloroethene	1/16	6.28E-01	6.60E+00	No	1.00E+00	µg/L	Yes	Yes	No	No
VOCs	Groundwater	Toluene	6/16	1.56E+01	1.90E+02	No	1.00E+03	µg/L	Yes	No	No	No
VOCs	Groundwater	trans-1,2-Dichloroethene	1/16	2.34E-01	9.00E-01	No	1.00E+02	µg/L	Yes	No	No	No
VOCs	Groundwater	Trichloroethene	1/16	6.94E-01	7.50E+00	No	1.00E+00	µg/L	Yes	Yes	No	No
VOCs	Groundwater	Vinyl Chloride	2/16	4.09E-01	2.40E+00	Yes	5.00E+00	µg/L	Yes	No	No	Yes
VOCs	Groundwater	Xylene (Total)	8/16	8.19E+01	8.90E+02	No	1.00E+03	µg/L	Yes	No	No	No

Notes:
All groundwater depths combined for this screening.
ND values replaced with half-SQL for these calculations.
Duplicate results handled as individual values.
Chemicals that were not detected in any of the monitoring wells were excluded from this table.

Table 6. Bayonne Barrel & Drum - Screening of Soil Results

Chem Class	Media	Parameter	Detect Freq	Avg Conc	Max Pos Conc	Class A Carc?	NJ Non-Res Direct Contact Soil	Units	Freq>5%	Max > Soil Value	Avg > Soil Value	Retain as COC?
Aroclor PCBs	Soils	Aroclor-1232	4/312	2.07E+00	2.20E+01	No (Class B2)	2.00E+00	mg/Kg	No	Yes	Yes	No
Aroclor PCBs	Soils	Aroclor-1242	54/312	6.55E+00	5.50E+02	No (Class B2)	2.00E+00	mg/Kg	Yes	Yes	Yes	Yes, as total PCBs
Aroclor PCBs	Soils	Aroclor-1248	118/332	3.41E+01	3.40E+03	No (Class B2)	2.00E+00	mg/Kg	Yes	Yes	Yes	Yes, as total PCBs
Aroclor PCBs	Soils	Aroclor-1254	231/335	5.30E+01	1.80E+03	No (Class B2)	2.00E+00	mg/Kg	Yes	Yes	Yes	Yes, as total PCBs
Aroclor PCBs	Soils	Aroclor-1260	195/327	7.58E+00	1.20E+02	No (Class B2)	2.00E+00	mg/Kg	Yes	Yes	Yes	Yes, as total PCBs
Aroclor PCBs	Soils	Aroclor-1262	19/276	1.76E+00	2.20E+01	No (Class B2)	2.00E+00	mg/Kg	Yes	Yes	No	No
Aroclor PCBs	Soils	Aroclor-1268	6/276	1.39E+00	2.10E+00	No (Class B2)	2.00E+00	mg/Kg	No	Yes	No	No
Aroclor PCBs	Soils	Total PCBs	265/312	7.38E+01	3.52E+03	No (Class B2)	2.00E+00	mg/Kg	Yes	Yes	Yes	Yes
Metals	Soils	Aluminum	79/79	4.99E+03	1.29E+04	No		mg/Kg	Yes	No	No	No
Metals	Soils	Antimony	63/77	2.95E+01	3.16E+02	No	4.00E+01	mg/Kg	Yes	Yes	No	No
Metals	Soils	Arsenic	76/79	1.94E+01	1.11E+02	Yes	2.00E+01	mg/Kg	Yes	Yes	No	Yes
Metals	Soils	Barium	79/79	1.21E+03	8.92E+03	No	4.70E+04	mg/Kg	Yes	No	No	No
Metals	Soils	Beryllium	74/79	4.77E-01	2.78E+00	No (Class B1)	2.00E+00	mg/Kg	Yes	Yes	No	No
Metals	Soils	Cadmium	65/78	2.04E+01	1.43E+02	No (Class B1)	1.00E+02	mg/Kg	Yes	Yes	No	No
Metals	Soils	Calcium	79/79	1.14E+04	1.25E+05	No		mg/Kg	Yes	No	No	No
Metals	Soils	Chromium	80/80	6.66E+02	3.11E+04	No		mg/Kg	Yes	No	No	No
Metals	Soils	Cobalt	79/79	2.51E+01	1.36E+02	No		mg/Kg	Yes	No	No	No
Metals	Soils	Copper	79/79	4.06E+02	1.87E+03	No	6.00E+02	mg/Kg	Yes	Yes	No	No
Metals	Soils	Iron	79/79	4.97E+04	7.21E+05	No		mg/Kg	Yes	No	No	No
Metals	Soils	Lead	140/140	6.55E+03	1.98E+05	No (Class B2)	6.00E+02	mg/Kg	Yes	Yes	Yes	Yes
Metals	Soils	Magnesium	79/79	2.09E+03	9.48E+03	No		mg/Kg	Yes	No	No	No
Metals	Soils	Manganese	79/79	3.60E+02	4.47E+03	No		mg/Kg	Yes	No	No	No
Metals	Soils	Mercury	67/77	4.16E+00	4.39E+01	No	2.70E+02	mg/Kg	Yes	No	No	No
Metals	Soils	Nickel	79/79	7.90E+01	1.05E+03	No	2.40E+03	mg/Kg	Yes	No	No	No
Metals	Soils	Selenium	37/76	4.47E+00	5.63E+01	No	3.10E+03	mg/Kg	Yes	No	No	No
Metals	Soils	Silver	58/76	3.95E+00	5.67E+01	No	4.10E+03	mg/Kg	Yes	No	No	No
Metals	Soils	Sodium	55/71	3.78E+02	2.31E+03	No		mg/Kg	Yes	No	No	No
Metals	Soils	Thallium	12/72	1.28E+00	2.31E+00	No	2.00E+00	mg/Kg	Yes	Yes	No	No
Metals	Soils	Vanadium	79/79	2.56E+01	6.77E+01	No	7.10E+03	mg/Kg	Yes	No	No	No
Metals	Soils	Zinc	79/79	1.42E+03	1.17E+04	No	1.50E+03	mg/Kg	Yes	Yes	No	No
PCDD/Fs	Soils	1,2,3,4,6,7,8,9-OCDD	142/191	2.94E+01	6.98E+02	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	1,2,3,4,6,7,8,9-OCDF	149/191	6.02E+02	4.42E+04	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	1,2,3,4,6,7,8-HpCDD	97/197	3.71E+00	7.98E+01	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	1,2,3,4,6,7,8-HpCDF	169/197	3.79E+02	2.21E+04	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	1,2,3,4,7,8,9-HpCDF	45/194	1.75E+00	3.46E+01	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	1,2,3,4,7,8-HxCDD	16/192	2.29E-01	3.00E+00	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	1,2,3,4,7,8-HxCDF	150/197	9.18E+01	2.46E+03	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	1,2,3,6,7,8-HxCDD	19/194	3.10E-01	6.60E+00	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	1,2,3,6,7,8-HxCDF	99/197	1.01E+01	2.97E+02	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	1,2,3,7,8,9-HxCDD	21/194	3.12E-01	3.76E+00	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	1,2,3,7,8,9-HxCDF	14/194	3.23E-01	1.20E+01	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	1,2,3,7,8-PeCDD	12/192	2.60E-01	3.10E+00	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	1,2,3,7,8-PeCDF	80/197	8.46E+00	2.32E+02	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	2,3,4,6,7,8-HxCDF	62/197	7.28E+00	1.40E+02	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	2,3,4,7,8-PeCDF	114/197	2.46E+01	7.84E+02	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	2,3,7,8-TCDD	10/192	1.20E-01	1.20E+00	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	2,3,7,8-TCDF	152/197	1.20E+02	3.34E+03	No		mg/Kg	Yes	No	No	No
PCDD/Fs	Soils	PCDD/F TEQs	183/201	4.96E+01	1.49E+03			mg/Kg				Yes
Pesticides	Soils	4,4'-DDD	68/128	1.41E+00	3.90E+01	No (Class B2)	1.20E+01	mg/Kg	Yes	Yes	No	No
Pesticides	Soils	4,4'-DDE	101/133	1.64E+00	4.00E+01	No (Class B2)	9.00E+00	mg/Kg	Yes	Yes	No	No
Pesticides	Soils	4,4'-DDT	52/113	4.12E-01	3.60E+00	No (Class B2)	9.00E+00	mg/Kg	Yes	No	No	No
Pesticides	Soils	Aldrin	18/101	1.05E+00	6.20E+01	No (Class B2)	1.70E-01	mg/Kg	Yes	Yes	Yes	Yes
Pesticides	Soils	alpha-BHC	8/101	8.17E-02	1.20E-01	No		mg/Kg	Yes	No	No	No
Pesticides	Soils	beta-BHC	11/101	1.49E-01	4.40E+00	No		mg/Kg	Yes	No	No	No
Pesticides	Soils	Chlordane	16/99	3.68E+00	1.00E+02	Yes		mg/Kg	Yes	No	No	Yes
Pesticides	Soils	delta-BHC	13/100	1.98E-01	2.80E+00	No		mg/Kg	Yes	No	No	No
Pesticides	Soils	Dieldrin	56/100	4.37E-01	5.90E+00	No (Class B2)	1.80E-01	mg/Kg	Yes	Yes	Yes	Yes

Table 6. Bayonne Barrel & Drum - Screening of Soil Results

Chem Class	Media	Parameter	Detect Freq	Avg Conc	Max Pos Conc	Class A Carc?	NJ Non-Res Direct Contact Soil	Units	Freq>5%	Max > Soil Value	Avg > Soil Value	Retain as COC?
Pesticides	Soils	Endosulfan I	9/99	1.08E-01	1.50E+00	No	6.20E+03	mg/Kg	Yes	No	No	No
Pesticides	Soils	Endosulfan II	31/103	1.48E-01	1.90E+00	No		mg/Kg	Yes	No	No	No
Pesticides	Soils	Endosulfan sulfate	18/101	3.03E-01	1.40E+01	No		mg/Kg	Yes	No	No	No
Pesticides	Soils	Endrin	34/101	1.67E-01	1.40E+00	No	3.10E+02	mg/Kg	Yes	No	No	No
Pesticides	Soils	Endrin aldehyde	40/99	4.86E-01	2.80E+01	No		mg/Kg	Yes	No	No	No
Pesticides	Soils	Endrin ketone	40/99	4.27E-01	2.20E+01	No		mg/Kg	Yes	No	No	No
Pesticides	Soils	gamma-BHC (Lindane)	3/100	8.48E-02	4.40E-01	No	2.20E+00	mg/Kg	No	No	No	No
Pesticides	Soils	Heptachlor	19/99	1.70E-01	5.40E+00	No (Class B2)	6.50E-01	mg/Kg	Yes	Yes	No	No
Pesticides	Soils	Heptachlor epoxide	38/102	2.30E-01	5.50E+00	No (Class B2)		mg/Kg	Yes	No	No	No
Pesticides	Soils	Methoxychlor	42/100	1.04E+00	8.10E+01	No	5.20E+03	mg/Kg	Yes	No	No	No
SVOC TICs	Soils	Total SVOC TICs	36/39	8.86E+02	1.16E+04	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	1,2,4-Trichlorobenzene	29/58	4.11E+00	1.20E+02	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	1,2-Dichlorobenzene	25/57	3.50E+00	7.20E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	1,3-Dichlorobenzene	17/55	4.40E+00	9.20E-01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	1,4-Dichlorobenzene	21/58	4.53E+00	1.50E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	2,4,5-Trichlorophenol	2/55	4.89E+00	6.30E-02	No		mg/Kg	No	No	No	No
SVOCs	Soils	2,4-Dichlorophenol	2/55	4.90E+00	4.60E-02	No		mg/Kg	No	No	No	No
SVOCs	Soils	2,4-Dimethylphenol	17/57	4.83E+00	5.40E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	2,4-Dinitrotoluene	2/57	9.52E-01	4.00E-01	No (Class B2)		mg/Kg	No	No	No	No
SVOCs	Soils	2-Chloronaphthalene	1/56	4.82E+00	1.10E-01	No		mg/Kg	No	No	No	No
SVOCs	Soils	2-Chlorophenol	1/55	4.90E+00	4.00E-02	No		mg/Kg	No	No	No	No
SVOCs	Soils	2-Methylnaphthalene	69/78	1.11E+01	1.70E+02	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	2-Methylphenol	22/58	4.25E+00	2.20E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	4-Chloroaniline	1/55	4.87E+00	1.70E-01	No		mg/Kg	No	No	No	No
SVOCs	Soils	4-Methylphenol	38/61	1.94E+01	8.40E+02	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Acenaphthene	63/78	3.04E+00	4.80E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Acenaphthylene	65/86	2.29E+00	2.10E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Anthracene	76/84	2.26E+00	1.60E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Benzo(a)anthracene	79/91	3.38E+00	4.00E+01	No (Class B2)		mg/Kg	Yes	No	No	No
SVOCs	Soils	Benzo(a)pyrene	73/88	3.65E+00	5.00E+01	No (Class B2)		mg/Kg	Yes	No	No	No
SVOCs	Soils	Benzo(b)fluoranthene	71/86	3.55E+00	3.20E+01	No (Class B2)		mg/Kg	Yes	No	No	No
SVOCs	Soils	Benzo(g,h,i)perylene	70/83	3.71E+00	1.80E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Benzo(k)fluoranthene	66/82	2.48E+00	3.60E+01	No (Class B2)		mg/Kg	Yes	No	No	No
SVOCs	Soils	bis(2-Ethylhexyl)phthalate	79/93	1.02E+02	3.70E+03	No (Class B2)		mg/Kg	Yes	No	No	No
SVOCs	Soils	Butylbenzylphthalate	29/69	2.93E+01	1.40E+03	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Carbazole	43/62	1.64E+00	1.20E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Chrysene	82/91	4.46E+00	5.90E+01	No (Class B2)		mg/Kg	Yes	No	No	No
SVOCs	Soils	Dibenz(a,h)anthracene	43/70	8.12E-01	9.40E+00	No (Class B2)		mg/Kg	Yes	No	No	No
SVOCs	Soils	Dibenzofuran	46/64	4.62E+00	4.20E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Diethylphthalate	8/62	5.28E+00	4.60E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Dimethylphthalate	4/59	4.80E+00	1.10E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Di-n-butylphthalate	52/80	2.48E+01	5.80E+02	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Di-n-octylphthalate	25/67	5.11E+00	7.90E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Fluoranthene	86/94	5.58E+00	6.10E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Fluorene	60/76	4.05E+00	8.40E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Hexachlorobenzene	5/57	6.31E+00	2.50E+02	No (Class B2)		mg/Kg	Yes	No	No	No
SVOCs	Soils	Hexachlorocyclopentadiene	1/55	4.94E+00	4.00E+00	No		mg/Kg	No	No	No	No
SVOCs	Soils	Indeno(1,2,3-cd)pyrene	67/81	1.77E+00	1.40E+01	No (Class B2)		mg/Kg	Yes	No	No	No
SVOCs	Soils	Isophorone	46/78	4.65E+00	6.80E+01	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Naphthalene	76/86	1.76E+01	5.40E+02	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	N-Nitrosodiphenylamine	5/56	1.17E+01	3.80E+02	No (Class B2)		mg/Kg	Yes	No	No	No
SVOCs	Soils	Pentachlorophenol	3/56	1.85E+01	8.50E-01	No (Class B2)		mg/Kg	Yes	No	No	No
SVOCs	Soils	Phenanthrene	84/91	9.23E+00	1.50E+02	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Phenol	21/61	7.65E+00	1.90E+02	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Potassium	74/79	4.70E+02	1.88E+03	No		mg/Kg	Yes	No	No	No
SVOCs	Soils	Pyrene	88/94	8.03E+00	6.90E+01	No		mg/Kg	Yes	No	No	No
TPH	Soils	Total Petroleum Hydrocarbons	76/83	1.70E+04	2.45E+05	No	1.00E+04	mg/Kg	Yes	Yes	Yes	Yes

Table 6. Bayonne Barrel & Drum - Screening of Soil Results

Chem Class	Media	Parameter	Detect Freq	Avg Conc	Max Pos Conc	Class A Carc?	NJ Non-Res Direct Contact Soil	Units	Freq>5%	Max > Soil Value	Avg > Soil Value	Retain as COC?
VOC TICs	Soils	Total VOC TICs	59/102	4.61E+02	1.05E+04	No (Class B2)	5.00E+02	mg/Kg	Yes	Yes	No	No
VOCs	Soils	1,1,1-Trichloroethane	4/106	1.49E+01	6.80E+02	No	1.00E+03	mg/Kg	No	No	No	No
VOCs	Soils	1,1,2,2-Tetrachloroethane	2/106	1.35E+00	1.20E+00	No	7.00E+01	mg/Kg	No	No	No	No
VOCs	Soils	1,1,2-Trichloroethane	3/104	3.92E+00	2.60E+01	No	4.20E+02	mg/Kg	No	No	No	No
VOCs	Soils	1,1-Dichloroethane	3/104	6.75E+00	4.00E-01	No	1.00E+03	mg/Kg	No	No	No	No
VOCs	Soils	1,2-Dichloroethane	1/105	2.70E+00	2.80E-02	No (Class B2)	2.40E+01	mg/Kg	No	No	No	No
VOCs	Soils	2-Butanone	4/108	6.51E+00	6.70E-02	No	1.00E+03	mg/Kg	No	No	No	No
VOCs	Soils	4-Methyl-2-Pentanone	5/107	1.90E+01	8.00E+02	No	1.00E+03	mg/Kg	No	No	No	No
VOCs	Soils	Acetone	15/117	6.13E+00	8.70E+00	No	1.00E+03	mg/Kg	Yes	No	No	No
VOCs	Soils	Benzene	52/110	2.87E+00	5.40E+01	Yes	1.30E+01	mg/Kg	Yes	Yes	No	Yes
VOCs	Soils	Carbon Disulfide	6/108	6.50E+00	1.60E-01	No		mg/Kg	Yes	No	No	No
VOCs	Soils	Carbon Tetrachloride	1/104	2.76E+00	1.30E-01	No (Class B2)	4.00E+00	mg/Kg	No	No	No	No
VOCs	Soils	Chlorobenzene	45/106	8.30E+00	1.20E+02	No	6.80E+02	mg/Kg	Yes	No	No	No
VOCs	Soils	Chloroform	1/104	6.76E+00	2.60E-01	No (Class B2)	2.80E+01	mg/Kg	No	No	No	No
VOCs	Soils	cis-1,2-Dichloroethene	12/104	6.17E+00	3.90E+01	No	1.00E+03	mg/Kg	Yes	No	No	No
VOCs	Soils	Ethylbenzene	79/124	8.36E+01	1.30E+03	No	1.00E+03	mg/Kg	Yes	Yes	No	No
VOCs	Soils	Methylene Chloride	4/107	5.75E+00	1.90E+02	No	2.10E+02	mg/Kg	No	No	No	No
VOCs	Soils	Styrene	4/105	2.02E+01	1.20E+03	No	9.70E+01	mg/Kg	No	Yes	No	No
VOCs	Soils	Tetrachloroethene	14/108	1.57E+00	3.60E+01	No	6.00E+00	mg/Kg	Yes	Yes	No	No
VOCs	Soils	Toluene	106/132	2.85E+02	1.00E+04	No	1.00E+03	mg/Kg	Yes	Yes	No	No
VOCs	Soils	trans-1,2-Dichloroethene	1/104	6.76E+00	6.80E-02	No	1.00E+03	mg/Kg	No	No	No	No
VOCs	Soils	Trichloroethene	19/110	6.62E+00	3.00E+02	No	5.40E+01	mg/Kg	Yes	Yes	No	No
VOCs	Soils	Vinyl Chloride	4/104	6.75E+00	1.20E+00	Yes	7.00E+00	mg/Kg	No	No	No	Yes

Notes:
All soil depths were combined for this screening.
ND values replaced with half-SQL for these calculations.
Duplicate results handled as individual values.
Chemicals that were not detected in any soil samples were excluded from this table.

Table 7a. Bayonne Barrel & Drum - Exposure Point Concentrations for Groundwater
Post-Remedy Conditions

Media	Receptors	Location	Chemical	Detect Freq	Mean Conc	Maximum Positive Value	EPC	ProUCL Recommendation	Units
Groundwater	Inspection/Repair Workers	Site-Wide	Arsenic	10/16	8.88	44.9	15.0	Approximate Gamma UCL	µg/L
			Benzo(a)anthracene	1/16	1.76	27.0	18.5	99% Chebyshev (Mean, Sd) UCL	µg/L
			Benzene	7/16	46.12	390.0	339.5	99% Chebyshev (Mean, Sd) UCL	µg/L
			Vinyl Chloride	2/16	0.41	2.4	1.0	95% Chebyshev (Mean, Sd) UCL	µg/L

Notes:
The EPCs were generated using ProUCL (USEPA, 2004d) and represent the upper confidence limit (UCL) of the mean values.
Non-detect values replaced with half-SQL for these calculations.
Duplicate results handled as individual values for these calculations.

Table 7b. Bayonne Barrel & Drum - Soil Exposure Point Concentrations for Inspection/Repair Workers
Post-Remedy Conditions for Principal Threat Excavation (PTE) Removal and Replacement with One-Half the Detection Limits

Media	Location(s)	Chemical	Detect Freq	Mean Conc	Maximum Positive Value	EPC	ProUCL Recommendation	Units
All Soils	Site-Wide	Arsenic	71/79	1.76E+01	1.11E+02	2.23E+01	Approximate Gamma UCL	mg/Kg
		Lead	105/136	1.50E+03	1.66E+04	3.59E+03	99% Chebyshev (Mean, Sd) UCL	mg/Kg
		Aldrin	17/89	1.19E+00	6.20E+01	8.66E+00	99% Chebyshev (Mean, Sd) UCL	mg/Kg
		Chlordane	16/97	3.76E+00	1.00E+02	1.31E+01	97.5% Chebyshev (Mean, Sd) UCL	mg/Kg
		Dieldrin	55/98	4.46E-01	5.90E+00	1.35E+00	Adjusted Gamma UCL	mg/Kg
		Benzene	49/108	2.87E+00	5.40E+01	8.85E+00	97.5% Chebyshev (Mean, Sd) UCL	mg/Kg
		Vinyl Chloride	4/92	MNC	1.20E+00	1.20E+00	97.5% Chebyshev (Mean, Sd) UCL, but exceeded the max positive so used the latter as the EPC.	mg/Kg
		Total PCBs	241/340	3.18E+01	4.54E+02	6.66E+01	99% Chebyshev (Mean, Sd) UCL	mg/Kg
		PCDD/F TEQs	130/188	5.29E+00	8.57E+01	1.35E+01	99% Chebyshev (Mean, Sd) UCL	µg/Kg

Notes:
The EPCs were generated using ProUCL (USEPA, 2004d) and represent the upper confidence limit (UCL) of the mean values.
"ND" is not detected or not determined for these samples.
"MNC" is mean not calculated. Mean value exceeds maximum positive result.
Non detect values replaced with half-SQL for these calculations.
Duplicate results handled as individual values for these calculations.

Table 8. Bayonne Barrel and Drum - Summary of Chemical-Specific Oral and Dermal Absorption Values and Permeability Coefficients

Chemical of Potential Concern	Oral Absorption[a] (unitless)	Dermal Absorption[a] (unitless)	Permeability Coefficient[a] (cm/hr)
Arsenic	0.95	0.03	0.00193[b]
Lead	0.15[b]	0.001[b]	0.0001
Benzo(a)anthracene	0.89	0.13	0.47
Benzene	0.97[b]	c	0.015
Vinyl chloride (inc early life)	1	c	0.0056
Vinyl chloride (adult)	1	c	0.0056
Dioxin TEQ (as TCDD)	1	0.03	0.81
Total PCBs	1	0.14	0.922[b]

Notes:

a. Values are from EPA (2001), Exhibits B-3 and B-4, unless otherwise noted.

b. ORNL (2005) - Oak Ridge National Laboratory Toxicity and Chemical – Specific Factors Data Base.

c. No dermal absorption values are presented for volatile compounds. EPA (2001) does not consider dermal exposure to volatile organic compounds present in soil to be significant.

Table 9. Bayonne Barrel and Drum - Summary of Cancer Slope Factors and Reference Doses for the Evaluated Chemicals

COPC	CSF $(mg/kg\text{-}day)^{-1}$		RfD (mg/kg-day)	
	Oral	Inhalation	Oral	Inhalation
Dioxin TEQ	1.50E+05	1.50E+05	[a]	[a]
Total PCBs	2.00E+00	2.00E+00	2.0E-05	2.0E-05
Aldrin	1.70E+01	1.70E+01	3.0E-05	3.0E-05
Arsenic	1.50E+00	1.50E+01	3.0E-04	3.0E-04
Benzene	5.50E-02	2.70E-02	4.0E-03	8.6E-03
Benzo(a)anthracene	7.30E-01	[b]	[a]	[a]
Chlordane	3.50E-01	3.50E-01	5.0E-04	2.0E-04
Dieldrin	1.60E+01	1.60E+01	5.0E-05	5.0E-05
Vinyl Chloride	7.50E-01	1.60E-02	3.00E-03	2.90E-02

Note:
Lead was evaluated on a concentration basis only.
[a]: Not assessed for non-cancer endpoints.
[b]: Not assessed as inhalation hazard.

Table 10. Bayonne Barrel & Drum - Potential Cancer and Non-Cancer Risks for Inspection/Repair Workers Based on Groundwater Following Site Remediation

A. Potential Cancer Risks

Receptor	Medium	Chemicals of Concern	CTE Case				RME Case			
			Ingestion	Inhalation	Dermal	Combined Routes	Ingestion	Inhalation	Dermal	Combined Routes
Inspection/Repair Worker	Groundwater	Arsenic	2.9E-10	NA	2.5E-10	5.4E-10	4.8E-10	NA	4.2E-10	8.9E-10
		Benzo(a)anthracene	1.7E-10	NA	7.1E-08	7.1E-08	2.9E-10	NA	1.2E-07	1.2E-07
		Benzene	2.4E-10	NA	3.1E-09	3.4E-09	4.0E-10	NA	5.2E-09	5.6E-09
		Vinyl Chloride	9.3E-12	NA	4.6E-11	5.5E-11	1.6E-11	NA	7.6E-11	9.2E-11
		Chemical Total	*7.0E-10*	NA	*7.4E-08*	*7.5E-08*	*1.2E-09*	NA	*1.2E-07*	*1.2E-07*

Notes:
"NA": pathway was not assessed.
For potential carcinogenic risks a value greater than 1E-6 is above threshold value.

B. Potential Non-Cancer Risks

Receptor	Medium	Chemicals of Concern	CTE Case				RME Case			
			Ingestion	Inhalation	Dermal	Combined Routes	Ingestion	Inhalation	Dermal	Combined Routes
Inspection/Repair Worker	Groundwater	Arsenic	4.8E-05	NA	4.2E-05	8.9E-05	4.8E-05	NA	4.2E-05	8.9E-05
		Benzo(a)anthracene	0	NA	0	0.0E+00	0	NA	0	0.0E+00
		Benzene	8.1E-05	NA	1.1E-03	1.1E-03	8.1E-05	NA	1.1E-03	1.1E-03
		Vinyl Chloride	3.2E-07	NA	1.6E-06	1.9E-06	3.2E-07	NA	1.6E-06	1.9E-06
		Chemical Total	*1.3E-04*	*NA*	*4.4E-03*	*1.2E-03*	*1.3E-04*	*NA*	*4.4E-03*	*1.2E-03*

Notes:
"NA": pathway was not assessed.
For potential non-carcinogenic risk an HQ value greater than 1 is above threshold value.

Table 11. Bayonne Barrel & Drum - Potential Cancer and Non-Cancer Risks for Inspection/Repair Workers Based on Soil Contact Following Site Remediation

A. Potential Cancer Risks

Receptor	Medium	Chemicals of Concern	CTE Case				RME Case			
			Ingestion	Inhalation	Dermal	Combined Routes	Ingestion	Inhalation	Dermal	Combined Routes
Inspection/Repair Worker	Soil	Dioxin TEQ	3.4E-07	1.9E-09	3.1E-08	3.7E-07	5.7E-07	3.1E-09	5.1E-08	6.2E-07
		Total PCBs	2.2E-08	1.2E-10	9.4E-09	3.2E-08	3.7E-08	2.0E-10	1.6E-08	5.3E-08
		Aldrin	2.5E-08	1.3E-10	7.4E-09	3.2E-08	4.1E-08	2.2E-10	1.2E-08	5.4E-08
		Arsenic	5.6E-09	3.1E-10	5.1E-10	6.4E-09	9.4E-09	5.1E-10	8.4E-10	1.1E-08
		Chlordane	7.7E-10	4.2E-12	9.2E-11	8.6E-10	1.3E-09	7.0E-12	1.5E-10	1.4E-09
		Dieldrin	3.6E-09	2.0E-11	1.1E-09	4.7E-09	6.0E-09	3.3E-11	1.8E-09	7.9E-09
		Benzene	8.2E-11	2.2E-13	NA	8.2E-11	1.4E-10	3.6E-13	NA	1.4E-10
		Vinyl Chloride	1.5E-10	1.8E-14	NA	1.5E-10	2.4E-10	2.9E-14	NA	2.4E-10
		Cumulative Total	*4.0E-07*	*2.4E-09*	*4.9E-08*	*4.5E-07*	*6.6E-07*	*4.1E-09*	*8.2E-08*	*7.5E-07*

Notes:
"NA": pathway was not assessed.
For potential carcinogenic risks a value greater than 1E-6 is above threshold value. These are shown in bold.

B. Potential Non-Cancer Risks

Receptor	Medium	Chemicals of Concern	CTE Case				RME Case			
			Ingestion	Inhalation	Dermal	Combined Routes	Ingestion	Inhalation	Dermal	Combined Routes
Inspection/Repair Worker	Soil	Dioxin TEQ	NA	NA	NA	0.0E+00	NA	NA	NA	0.0E+00
		Total PCBs	4.2E-02	2.3E-04	1.8E-02	6.0E-02	4.2E-02	2.3E-04	1.8E-02	6.0E-02
		Aldrin	3.6E-03	2.0E-05	1.1E-03	4.7E-03	3.6E-03	2.0E-05	1.1E-03	4.7E-03
		Arsenic	9.4E-04	5.1E-06	8.4E-05	1.0E-03	9.4E-04	5.1E-06	8.4E-05	1.0E-03
		Chlordane	3.3E-04	4.5E-06	3.9E-05	3.7E-04	3.3E-04	4.5E-06	3.9E-05	3.7E-04
		Dieldrin	3.4E-04	1.8E-06	1.0E-04	4.4E-04	3.4E-04	1.8E-06	1.0E-04	4.4E-04
		Benzene	2.8E-05	7.1E-08	NA	2.8E-05	2.8E-05	7.1E-08	0.0E+00	2.8E-05
		Vinyl Chloride	5.0E-06	2.8E-09	NA	5.0E-06	5.0E-06	2.8E-09	0.0E+00	5.0E-06
		Cumulative Total	*4.7E-02*	*2.6E-04*	*1.9E-02*	*6.6E-02*	*4.7E-02*	*2.6E-04*	*1.9E-02*	*6.6E-02*

Notes:
"NA": pathway was not assessed.
For potential non-carcinogenic risk an HQ value greater than 1 is above threshold value. These are shown in bold.

Table 12. Uncertainty Assessment - Screening of Chemicals of Concern in Groundwater - Chemicals that Pass Screening as Maximum Values

Parameter	Units	Detect Freq	Avg Conc	Max Pos Conc	Freq>5%	NJ GW Class IIA Value	Max > NJ GW Class IIA Value	Avg > NJ GW Class IIA Value	EPA Region III RBC	EPA Region IX PRG	Max > RBC	Max > PRG
Aluminum	µg/L	14/16	1.71E+02	1.06E+03	Yes	2.00E+02	Yes	No	3.65E+04	3.6E+04	No	No
Antimony	µg/L	4/16	7.34E+00	6.22E+01	Yes	2.00E+01	Yes	No	1.50E+01	1.46E+01	Yes	Yes
Lead	µg/L	5/16	4.90E+00	4.14E+01	Yes	1.00E+01	Yes	No	—	—	—	—
Chrysene	µg/L	1/16	1.57E+00	2.40E+01	Yes	5.00E+00	Yes	No	9.17E+00	9.2E+00	Yes	Yes
1,1,2-Trichloroethane	µg/L	1/16	5.75E-01	6.50E+00	Yes	3.00E+00	Yes	No	1.88E-01	2.0E-01	Yes	Yes
Methylene Chloride	µg/L	1/16	9.00E-01	6.30E+00	Yes	3.00E+00	Yes	No	—	4.28E+00	—	Yes
Tetrachloroethene	µg/L	1/16	6.28E-01	6.60E+00	Yes	1.00E+00	Yes	No	1.04E-01	1.0E-01	Yes	Yes
Trichloroethene	µg/L	1/16	6.94E-01	7.50E+00	Yes	1.00E+00	Yes	No	2.64E-02	2.8E-02	Yes	Yes

Notes:
The mean concentrations were used to screen for COPCs. The parameters shown above were not retained as part of the original screen.
The EPA Region III Risk Based Concentrations (RBCs) are based on tap water since these are the only water values provided (USEPA, 2005). Values for methylene chloride and lead were not available from EPA Region III so the EPA Region IX PRG was used (USEPA, 2004).

Table 13. Uncertainty Assessment - Screening of Chemicals of Concern in Soils - Chemicals that Pass Screening as Maximum Values

Parameter	Units	Detect Freq	Avg Conc	Max Pos Conc	Freq>5%	NJ Non-Res Direct Contact Soil	Max > Soil Value	Avg > Soil Value	EPA Region III RBC	EPA Region IX PRG	Max > RBC	Max > PRG
Antimony	mg/Kg	63/77	2.95E+01	3.16E+02	Yes	4.00E+01	Yes	No	8.18E+02	4.09E+02	No	No
Beryllium	mg/Kg	74/79	4.77E-01	2.78E+00	Yes	2.00E+00	Yes	No	4.09E+03	1.94E+03	No	No
Cadmium	mg/Kg	65/78	2.04E+01	1.43E+02	Yes	1.00E+02	Yes	No	2.04E+03	4.51E+02	No	No
Copper	mg/Kg	79/79	4.06E+02	1.87E+03	Yes	6.00E+02	Yes	No	8.18E+04	4.09E+04	No	No
Thallium	mg/Kg	12/72	1.28E+00	2.31E+00	Yes	2.00E+00	Yes	No	1.43E+02	6.75E+01	No	No
Zinc	mg/Kg	79/79	1.42E+03	1.17E+04	Yes	1.50E+03	Yes	No	6.13E+05	1.00E+05	No	No
4,4'-DDD	mg/Kg	68/128	1.41E+00	3.90E+01	Yes	1.20E+01	Yes	No	2.38E+01	9.95E+00	Yes	Yes
4,4'-DDE	mg/Kg	101/133	1.64E+00	4.00E+01	Yes	9.00E+00	Yes	No	1.68E+01	7.02E+00	Yes	Yes
Heptachlor	mg/Kg	19/99	1.70E-01	5.40E+00	Yes	6.50E-01	Yes	No	1.27E+00	3.83E-01	Yes	Yes
Ethylbenzene	mg/Kg	79/124	8.36E+01	1.30E+03	Yes	1.00E+03	Yes	No	2.04E+05	3.95E+02	No	Yes
Tetrachloroethene	mg/Kg	14/106	1.57E+00	3.60E+01	Yes	6.00E+00	Yes	No	1.10E+02	1.31E+00	No	Yes
Toluene	mg/Kg	106/132	2.85E+02	1.00E+04	Yes	1.00E+03	Yes	No	4.09E+05	5.20E+02	No	Yes
Trichloroethene	mg/Kg	19/110	5.62E+00	3.00E+02	Yes	5.40E+01	Yes	No	5.20E+02	1.15E-01	No	Yes

Note:
Aroclor-1262 also fell into this group of chemicals but was evaluated as a COPC as part of the Total PCBs.

Table 14. Uncertainty Assessment - Comparison of Calculated Risks Using the Mean as the Exposure Point Concentration for Inspection/Repair Workers Based on Exposure to Surface and Subsurface Soil Following Site Remediation

A. Potential Cancer Risks

Receptor	Medium	Chemicals of Concern	CTE Case				RME Case			
			Ingestion	Inhalation	Dermal	Combined Routes	Ingestion	Inhalation	Dermal	Combined Routes
Inspection/Repair Worker	Soil	Dioxin TEQ	1.3E-07	7.3E-10	1.2E-08	1.5E-07	2.2E-07	1.2E-09	2.0E-08	2.4E-07
		Total PCBs	1.1E-08	5.8E-11	4.5E-09	1.5E-08	1.8E-08	9.7E-11	7.5E-09	2.5E-08
		Aldrin	3.4E-09	1.8E-11	1.0E-09	4.4E-09	5.7E-09	3.1E-11	1.7E-09	7.4E-09
		Arsenic	4.4E-09	2.4E-10	4.0E-10	5.1E-09	7.4E-09	4.0E-10	6.6E-10	8.4E-09
		Chlordane	2.2E-10	1.2E-12	2.7E-11	2.5E-10	3.7E-10	2.0E-12	4.4E-11	4.1E-10
		Dieldrin	1.2E-09	6.5E-12	3.6E-10	1.6E-09	2.0E-09	1.1E-11	6.0E-10	2.6E-09
		Benzene	2.6E-11	7.1E-14	NA	2.7E-11	4.4E-11	1.2E-13	NA	4.4E-11
		Vinyl Chloride	1.5E-10	1.8E-14	NA	1.5E-10	2.4E-10	2.9E-14	NA	2.4E-10
		Cumulative Total	*1.5E-07*	*1.1E-09*	*1.8E-08*	*1.7E-07*	*2.6E-07*	*1.8E-09*	*3.0E-08*	*2.9E-07*

Notes:
"NA": pathway was not assessed.
For potential carcinogenic risks a value greater than 1E-6 is above threshold value. These are shown in bold.

B. Potential Non-Cancer Risks

Receptor	Medium	Chemicals of Concern	CTE Case				RME Case			
			Ingestion	Inhalation	Dermal	Combined Routes	Ingestion	Inhalation	Dermal	Combined Routes
Inspection/Repair Worker	Soil	Dioxin TEQ	NA	NA	NA	0.0E+00	NA	NA	NA	0.0E+00
		Total PCBs	2.0E-02	1.1E-04	8.4E-03	2.9E-03	2.0E-02	1.1E-04	8.4E-03	2.9E-02
		Aldrin	5.0E-04	2.7E-06	1.5E-04	6.5E-05	5.0E-04	2.7E-06	1.5E-04	6.5E-04
		Arsenic	7.4E-04	4.0E-06	6.6E-05	8.1E-05	7.4E-04	4.0E-06	6.6E-05	8.1E-04
		Chlordane	9.5E-05	1.3E-06	1.1E-05	1.1E-05	9.5E-05	1.3E-06	1.1E-05	1.1E-04
		Dieldrin	1.1E-04	6.1E-07	3.4E-05	1.5E-05	1.1E-04	6.1E-07	3.4E-05	1.5E-04
		Benzene	9.0E-06	2.3E-08	NA	9.0E-07	9.0E-06	2.3E-08	NA	9.0E-06
		Vinyl Chloride	5.0E-06	2.8E-09	NA	5.0E-07	5.0E-06	2.8E-09	NA	5.0E-06
		Cumulative Total	*2.2E-02*	*1.2E-04*	*8.7E-03*	*3.0E-03*	*2.2E-02*	*1.2E-04*	*8.7E-03*	*3.0E-02*

Notes:
"NA": pathway was not assessed.
For potential non-carcinogenic risk an HQ value greater than 1 is above threshold value. These are shown in bold.

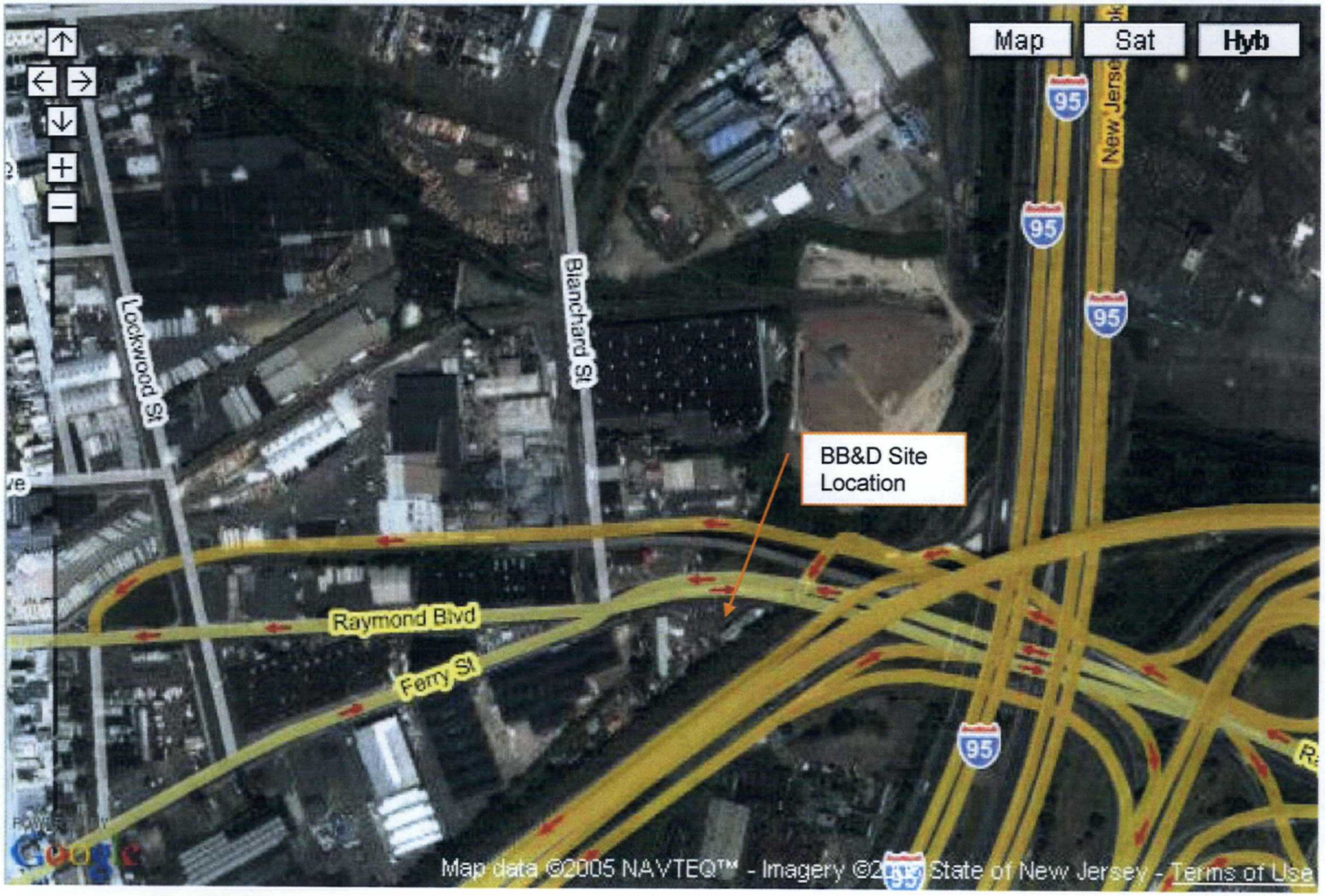

Figure 1. Bayonne Barrel & Drum Site Locator Map

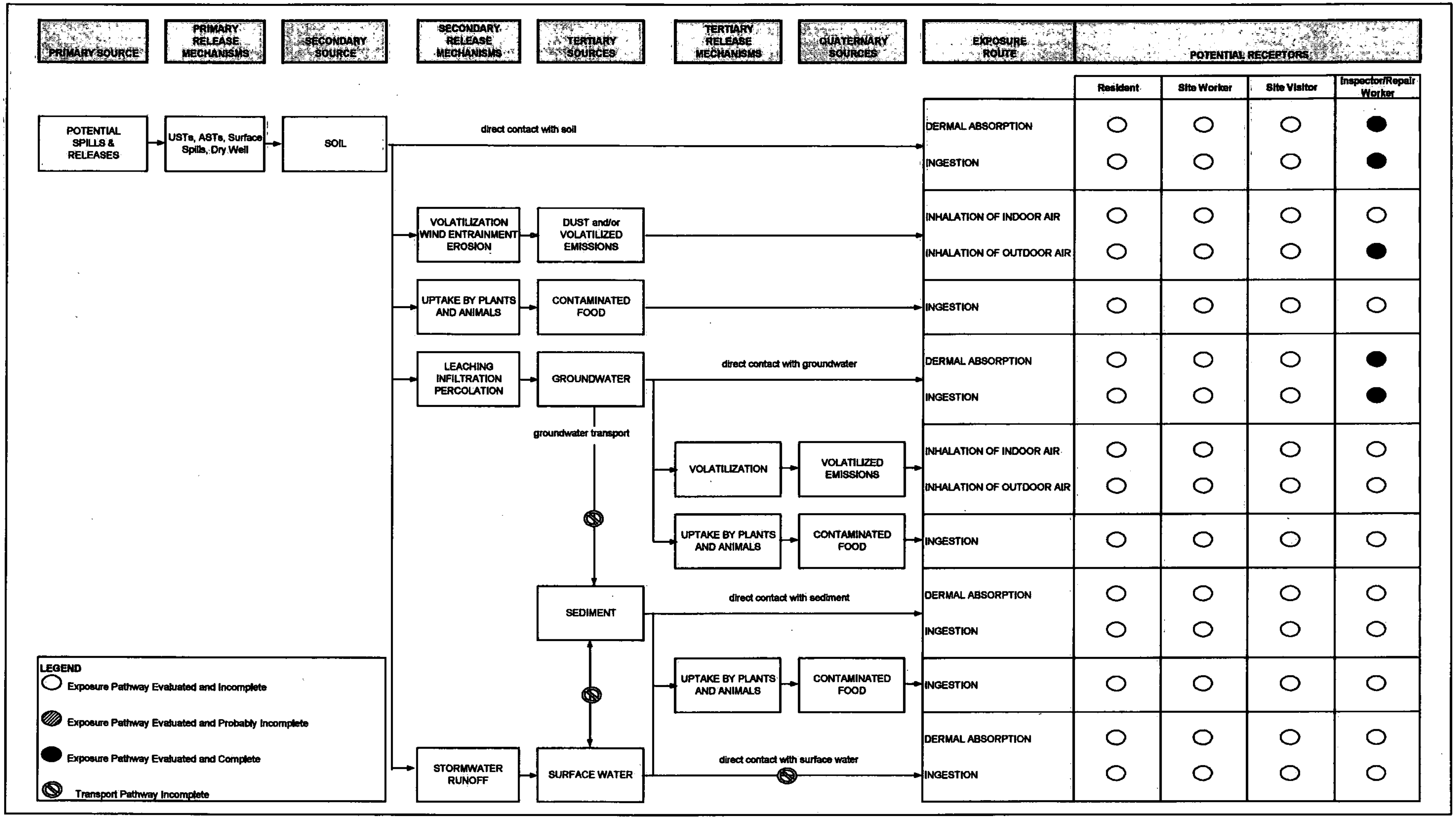

Figure 2. Conceptual Site Model of Potential Post-Remedy Exposure Pathways for Bayonne Barrel & Drum

Attachment 1
Records of Communication with Pipeline Owners (Williams Transco and PSE&G)

TO: Bayonne Barrel and Drum Site, Newark, NJ

FROM: W.J. Lee

DATE: December 21, 2005

RE: Access Requirements to Gas Pipelines in Existing Easements

Two gas pipeline easements cross portions of the Bayonne Barrel and Drum Site in Newark, NJ, one by PSE&G and one by Williams Transco. There are two pipelines within the PSE&G easement, a 30-inch line at 500 psi and a smaller diameter (estimated 15 to 20-inch) at 60 psi. The Williams Transco easement has a single 30-inch 750 psi line. This memo summarizes specific information obtained from both companies during site visits in September 2005 and by telephone conversations in September and December 2005, as well as general publicly available information regarding gas transmission pipelines and their safety.

With respect to site specific information, the following contacts were made:

1. PSE&G

   Bob Heiser, Transmission Inspector
   (201) 314-1161

   Barbara Altenberg, Asset Manager
   Public Service Electric & Gas
   80 Park Plaza, T14
   Newark, NJ 07102-4194

2. Williams Transco

   Alex Lanfranco, Inspector
   Joe Sacko, Supervisor
   Pete Masset, Pipeline Integrity
   (908) 862-8600

These representatives described the following tests and inspections that are routinely conducted in connection with gas transmission pipelines within the existing site easements:

- Twice monthly visual inspections, often just a drive by "window survey".

- Semi annual (twice per year) Gas Leak Survey, this entails the inspector walking the site with a gas instrument measuring ambient air.

- Annual Pipe Corrosion Tests, conducted by connecting a portable instrument to existing above-grade wires connected to the pipe below ground. The instrument needs to be in contact with the ground, but can be on clean material and can be adjusted to work on top of pavement.

- Ten Year Smart Pigging, involves pneumatic transmission of a smart pig through the pipeline. The smart pig both cleans the pipe and detects and measures for corrosion and dents. The sending and retrieving stations are not on-site.

All of these activities are non-invasive and would not result in contact with contaminated media beneath an engineered cap.

Both easement owners indicated that they require access to the pipes 24 hours per day, 365 days per year, but "there is a better chance of winning the lottery than there is that they would have ever have to dig for repair". Both also stated that the crews and/or contractors are trained to work on contaminated sites, but that because of the persistent testing and inspection of the lines, the likelihood of ever requiring an emergency repair is essentially nil.

In addition to these specific discussions relating to the Bayonne Barrel and Drum site, a general examination of readily available information concerning gas transmission pipelines has been reviewed. In testimony presented at the Oversight Hearing on Pipeline Safety to the US Senate's Committee on Commerce, Science and Transportation on June 15, 2004 by the Inspector General of the Department of Transportation, it was reported that more than 326,000 miles of natural gas transmission lines have been mapped in the United States. The Office of Pipeline Safety (OPS) has developed rules relating to Integrity Management Programs (IMP) and reports that inspection programs are working well. Additionally, statistics presented at an OPS Workshop on Direct Assessment (Houston, November 4, 2003) summarized the causes of gas transmission incidents and shows that approximately only fifty incidents occur each year. An "incident" describes a broad range of occurrences, only a small part of which would require mitigative measures that might entail excavation for repair, such as reducing the pipeline pressure or other suitable responses. Accordingly, less than 1 incident for every 6,520 miles of pipeline occurs each year, and only a portion of such incidents requires invasive access to the pipeline.

With less than one mile (in total) of gas transmission pipelines crossing the site, the OPS Report statistically supports the statement made during discussions by one of the utility owner representatives, that the likelihood for ever having to dig up the pipe for repair is nearly non-existent. The lifetime of gas transmission pipelines is reported to be "very long" with reports exceeding fifty years even prior to 1971 rules requiring cathodic protection and 2000 rules requiring integrity management programs. Both systems of protection and monitoring, which would extend pipeline longevity, are in place for the pipelines at the Bayonne Barrel and Drum site.

In view of the foregoing, a very conservative estimate of once every 15 years for pipeline access in connection with emergency repairs appears appropriate. However, even in that event, it is worth noting that any excavation beneath the engineered cap would most likely be conducted by trained workers in personal protective equipment (PPE).

/wjl